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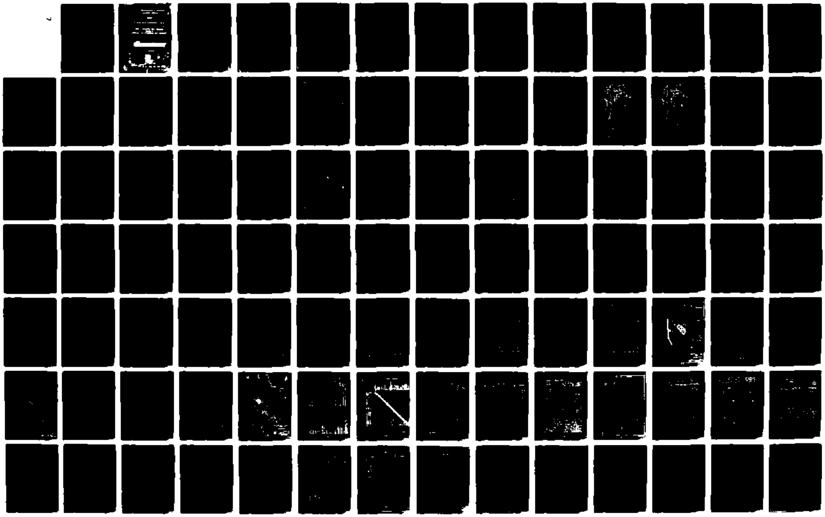

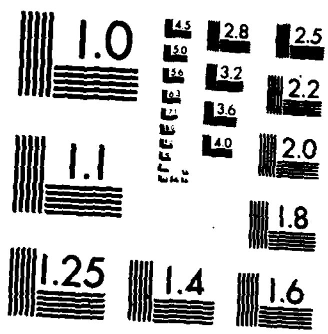
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Navigation
Environmental Impacts
Dredging
Disposal

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A combined Design Memorandum and Environmental Impact Statement for proposed navigation improvements at Central San Francisco Bay, California. The planning process and the design considerations that led to the selection of the plan and its alternatives as well as the environmental consequences resulting from the implementation of those plans are discussed in the report.

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SAN FRANCISCO BAY-TO-STOCKTON
CALIFORNIA
(JOHN F. BALDWIN & STOCKTON SHIP CHANNELS)

DRAFT
INTERIM DESIGN MEMORANDUM NO. 5
AND
ENVIRONMENTAL IMPACT STATEMENT

JOHN F. BALDWIN SHIP CHANNEL
PHASE II
CENTRAL SAN FRANCISCO BAY SEGMENT

December 1983

Department of the Army
San Francisco District, Corps of Engineers
San Francisco, California

INTERIM DESIGN MEMORANDUM NO. 5 AND ENVIRONMENTAL IMPACT STATEMENT
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
CENTRAL SAN FRANCISCO BAY SEGMENT

DESIGN MEMORANDUM

No.	Date	Title	Approved
1.	Sept 80	Avon to Stockton	18 Dec 81
2.	Nov 68	Bank Protection	20 Dec 68
3.	June 69	Levee Setbacks	6 Jan 70
4.	Apr 71	San Francisco Bar	17 Aug 71
5.	Nov 83	West Richmond Channel & Richmond Long Wharf	
6.		San Pablo Bay and Mare Island Strait	
7.		Carquinez Strait and Suisun Bay Channels	

INTERIM DESIGN MEMORANDUM NO. 5
JOHN F. BALDWIN PHASE II
Pertinent Data of Recommended Plan

1. GENERAL DATA

Name	San Francisco Bay to Stockton, California (John F. Baldwin and Stockton Ship Channels)
Authorization	River and Harbor Act of 1965 Public Law 89-298
Water Body	San Francisco Bay
Counties and State	Contra Costa and San Francisco, California
Purpose	Navigation
Local Sponsor	Contra Costa County

2. NAVIGATION DATA

Location	Central San Francisco Bay near Richmond, California
Length	1.1 miles (Maneuvering Area, irregular)
Depth	-45 feet MLLW
Bottom Width	600 Feet
Side Slopes	1V on 3H
Dredging	7,900,000 cys
Disposal	Aquatic at Alcatraz Disposal Site (SF-11).

3. ECONOMIC DATA

a.	First Costs		
	Federal	$41,700,000	
	Non-Federal	1,450,000	
	Total	$43,150,000	
b.	Inst. Dur. Const.	2,730,000	
c.	Annual Cost	(50 years @ 3-1/4%)	(50 years @ 7-7/8)
	Capital	$1,869,000	$3,697,000
	O&M	250,000	250,000
	Total	$2,119,000	$3,947,000
d.	Annual Benefits		
	Navigation	$5,632,000	$5,542,000
	Net Benefits	3,513,000	1,595,000
e.	Benefit-Cost Ratio	2.7 to 1	1.4 to 1

SYLLABUS

The purpose of this report is to recommend for construction, a plan of improvements for the Central San Francisco Bay segment of the John F. Baldwin Ship Channel. This project is part of the San Francisco Bay to Stockton Project authorized by Congress in 1965. The San Francisco District, U.S. Army Corps of Engineers is the responsible agency for the construction of the John F. Baldwin Ship Channel. The Sacramento District, U.S. Army Corps of Engineers is the responsible agency for the construction of the Avon to Stockton Ship Channel. Advanced engineering and design and construction of the John F. Baldwin Ship Channel is proceeding in three phases. Phase I was constructed in 1974 and consists of a Main Ship Channel 55 feet deep and 2000 feet wide across the San Francisco Bar. Phase II, the subject of this report, provides channel improvements in Central San Francisco Bay near Richmond, California. Phase III provides for channel improvements in San Pablo Bay, Carquinez Strait and Suisun Bay to Point Edith. The impetus for channel improvements in Central San Francisco Bay is the worldwide trend toward larger tankers with correspondingly deeper drafts, to transport crude petroleum and a progressive increase in the demand for crude petroleum.

Refinery facilities located at Richmond rely on waterborne transportation to supply most of their crude petroleum stocks. The present channel depth of -35 feet MLLW restricts the size of tankers that can safely use existing channels to 30-foot draft vessels. Deeper draft vessels generally in use today must be lightered or wait for high tides in order to use the existing channels to the refinery facilities. In addition the routing of larger tankers via the West Richmond Channel is considered risky due to man-made and natural obstructions to navigation.

Various solutions to the problems and needs related to inadequate deep-draft access to Richmond refining facilities were analyzed. Included were both dredging and non-dredging alternatives. The non-dredging alternatives gave consideration to a deep-water in-bay terminal and an ocean monobuoy system. Dredging alternatives considered improvements in either the Southampton Shoal Channel or the West Richmond Channel.

As presented herein, the provision of improved deep-water access to Richmond refining facilities is warranted and the Southampton Shoal Channel is the best route to provide that access. The Southampton Shoal Channel is the most direct and safest route to the Richmond refining facilities and it is the preferred route of the users. The proposed 45-foot depth will increase the number of tankers calling at Richmond without lightering or tidal delays by 38 percent over present day conditions.

The improvement of the Southampton Shoal Channel would consist of dredging 1.1 miles of existing channel and the existing Richmond Long Wharf Maneuvering Area from -35 feet (MLLW) to -45 feet (MLLW). An estimated 7,900,000 cubic yards of material would be dredged and disposed of in the approved Alcatraz Island Disposal Site. The estimated first cost of construction is $43,150,000. Annual costs are estimated at $2,119,000 including capital costs and operations and maintenance.

Transportation cost savings resulting from the recommended improvements would yield annual benefits of $5,632,000. These cost savings stem from the reduction in lightering and tidal delays. Other benefits which may result from the improvements include a reduction in the potential for accidental petroleum spills during lightering and the elimination of the need to navigate in a hazardous area. The project has a benefit/cost ratio of 2.7 to 1. Implementation of the recommended improvement will not adversely affect wetlands, endangered species or water quality of San Francisco Bay. The primary environmental impact of the project results from dredging and disposal operations which disturb benthic communities and increase turbidity levels at the dredging and disposal sites. These impacts manifest themselves in the lower portion of the food web of the San Francisco Bay System but, the overall effect on the biological productivity of the Bay is not considered to be of major consequence over the long term.

JOHN F. BALDWIN SHIP CHANNEL
PHASE II
CENTRAL SAN FRANCISCO BAY SEGMENT

DRAFT
INTERIM DESIGN MEMORANDUM NO. 5
AND
ENVIRONMENTAL IMPACT STATEMENT

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INTERIM DESIGN MEMORANDUM NO. 5 AND ENVIRONMENTAL IMPACT STATEMENT
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
CENTRAL SAN FRANCISCO BAY SEGMENT

SECTION 1

INTRODUCTION

1.01 This section presents information on the purpose, authorization, study area, scope, coordination, study methodology, report format and prior studies related to this Memorandum.

1.02 Purpose of Study. The purpose of this study is to evaluate (affirm o reformulate) the subject deep-draft navigation project using current engineering, economic, environmental and institutional criteria. The plan improvement recommended as a result of this evaluation is developed to an advanced level (General Design Memorandum) of detail so as to proceed dire y to the preparation of construction plans and specifications upon approval.

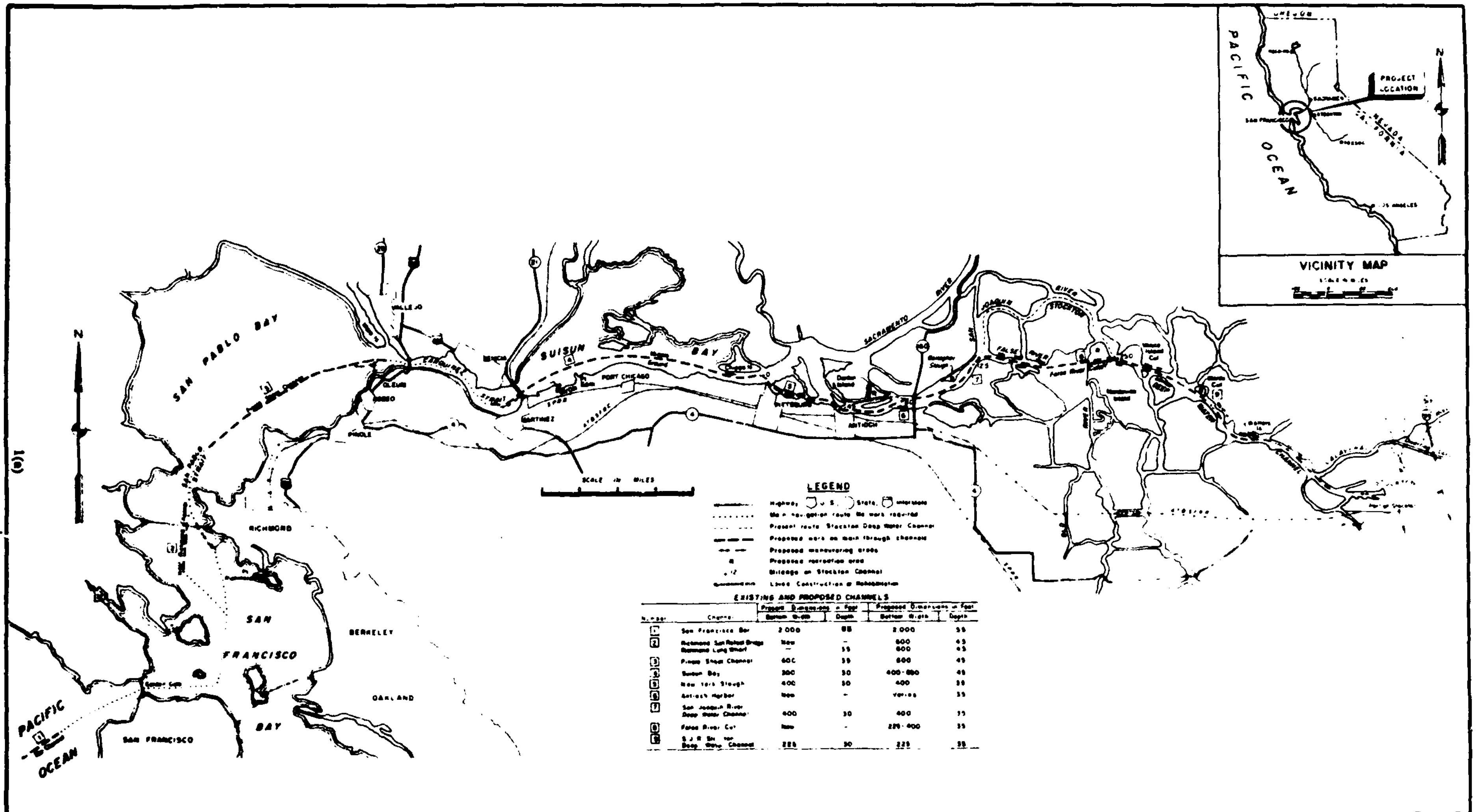
1.03 Authority. The San Francisco Bay to Stockton, California (John F. Baldwin and Stockton Ship Channels) Navigation Project was authorized by the River and Harbor Act of 1965 as contained in Public Law 89-298, Eighty-Ninth Congress, dated 27 October 1965. The authorization reads in part as follows:

> "The following works of improvement of rivers and harbors and other waterways for navigation . . . are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers in the respective reports hereinafter designated . . . San Francisco Bay to Stockton, California: House Document 208, Eighty-ninth Congress, at an estimated cost of $46,853,000."

1.04 Description of Authorized Project. The plan of improvement recommended in House Document 208, consists of modification to five existing channel projects and construction of a new channel in Carquinez Straits. The authorized improvements are briefly described in the following paragraphs and further summarized in Table 1. Figure 1 is a general map of the project area showing the location of each authorized project segments. All depths are relative to Mean Lower Low Water (MLLW).

a. Main Ship Channel - San Francisco Bar. The authorized improvements for the Main Ship Channel provide for deepening the channel across San Francisco Bar from 50 to 55 feet, but retaining the existing width of 2,000 feet. This work was completed in February 1974.

b. West Richmond Channel - Central San Francisco Bay. The authorized improvements consist of deepening the West Richmond Channel to a depth of 45 feet and a bottom width of 600 feet. The existing project maneuvering area near the Richmond Long Wharf, which now has a depth of 35 feet, would be deepened to 45 feet and extended toward deep water near the east navigation opening of the Richmond/San Rafael Bridge. This is the authorized segment addressed by this Interim Design Memorandum.



EXISTING AND PROPOSED CHANNELS

Number	Channel	Present Dimensions in Feet: Bottom Width	Present Dimensions in Feet: Depth	Proposed Dimensions in Feet: Bottom Width	Proposed Dimensions in Feet: Depth
1	San Francisco Bar	2,000	55	2,000	55
2	Richmond San Rafael Bridge	New	–	600	45
	Richmond Long Wharf	–	35	600	45
3	Pinole Shoal Channel	600	35	600	45
4	Suisun Bay	300	30	400-800	45
5	New York Slough	400	30	400	35
6	Antioch Harbor	New	-	Varies	35
7	San Joaquin River Deep Water Channel	400	30	400	35
8	False River Cut	New	-	250-400	35
9	S.J.R. Stockton Deep Water Channel	225	30	225	35

SAN FRANCISCO BAY TO STOCKTON
(John F. Baldwin and Stockton Ship Channels)
CALIFORNIA

U.S. ARMY ENGINEER DISTRICT
SAN FRANCISCO, CALIFORNIA

FILE NO.

FIGURE 1

TABLE 1

Existing Channels and Facilities
and Authorized Modifications

Existing Project No.	Channel or Facility	EXISTING Depth (feet)	EXISTING Width (feet)	AUTHORIZED MODIFICATION Depth (feet)	AUTHORIZED MODIFICATION Width (feet)
1	San Francisco Bar Channel: (Completed)	55	2,000	55	2,000
2	West Richmond Channel:	-	-	45	600
	Richmond Long Wharf Maneuvering Area	35	Irregular	45	Irregular
3	Pinole Shoal Channel: Oleum, Port Costa & Martinez Maneuvering Areas	35	600	45	600
4	Carquinez Strait Channel: (New Channel)	-	-	45	Irregular
5	Suisun Bay Channel:				
	Martinez to Avon	35	300	45	600
	Avon to Middle Point	30	300	45	600
	Middle Point to Chipps Island	30	300	45	400
	Chipps Island to New York Slough (Pittsburg)	30	300	35	400
6	Stockton Deep Water Channel:				
	Pittsburg to Antioch	30	400	35	400
	Antioch Harbor Area	-	-	35	400
	Antioch to Stockton				
	Antioch to False River	30	400	35	400
	False River Cutoff (new channel)	-	-	35	225-400
	False River Cutoff to Stockton	30	225	35	225 (*)

(*) 250 feet in bends.

c. Pinole Shoal Channel - San Pablo Bay. The Pinole Shoal Channel, which is within the limit of the San Pablo Bay and Mare Island Strait project, would be deepened to 45 feet across its present 600-foot bottom width and lengthened to approximaely 9 miles to connect the naturally deep waters of San Pablo Bay and Carquinez Strait. The maneuvering area near the Union Oil Company wharf at Oleum would be deepened to 45 feet and enlarged somewhat to accommodate larger tankers.

d. Carquinez Strait Channel. A new 45-foot deep and 600 to 800-foot wide channel would be excavated through the shoal areas of upper Carquinez Strait in the Martinez-Benicia complex. A maneuvering area south of the main channel in the vicinity of the Shell and Lyon (Tosco) Oil Company piers at Martinez would be deepened to 45 feet. The channel would taper to approximately 300 feet wide at the Interstate 680 highway bridge and the Southern Pacific Railroad Bridge to utilize the existing navigation openings under these bridges.

e. Suisun Bay Channel. The authorized improvement for Suisun Bay includes deepening the channel from the existing depths of 35 and 30 feet to 45 feet between Martinez and Chipps Island and to 35 feet from Chipps Island to New York Slough. Deepening the channel to 45 feet from Avon to Chipps Island is contingent upon development of a refinery near Chipps Island or development of other heavy industry requiring deep-draft ships. The authorization provides for widening the existing channel bottom to 600 feet upstream to Middle Point, east of the piers at the Concord Naval Weapons Station at Port Chicago, and to 400 feet upstream to the mouth of New York Slough. The channel between Martinez and Avon was deepened to 35 feet under the authority of Section 107 of the 1960 River and Harbor Act (P.L. 86-845) subsequent to authorization of the San Francisco Bay Stockton project.

f. Stockton Deep Water Channel.

(1) Pittsburg to Antioch. The authorized plan for improvement through New York Slough from Pittsburg to Antioch is to deepen the existing channel to 35 feet. The authorization also provides for the installation of bank protection on levees within 1,000 feet of channel along this reach over a 5-year period, and all necessary utility relocations.

(2) Antioch Harbor area. The authorized channel modifications in the vicinity of Antioch include realigning the channel south of West Island and providing a channel 400 feet wide and 35 feet deep. The authorization also provides for a branch of the channel to be extended along the south shore of San Joaquin River near Antioch to the Antioch Bridge. The channel extension would function as a maneuvering area and entrance channel to a potential harbor near to Antioch Bridge. A turning basin 1,200 feet square at 35 feet deep is authorized for construction between the potential harbor site and the through channel south of the upstream tip of West Island. Construction of the channel and turning basin south of West Island is dependent upon the need for deep water facilities along the south shore in the vicinity of Antioch. If the need for deep water facilities in that location does not materialize, deepening of the existing channel north of West Island to 35 feet is authorized. The authorization includes installation of bank protection on levees within 1,000 feet of the channel with construction to be accomplished at critical sites over a 5-year period after completion of the channel.

(3) Antioch to Stockton . The authorized channel modifications from Antioch to Stockton include deepening the existing 400-foot wide channel to 35 feet from Antioch Bridge to the mouth of False River, and constructing a new deep water channel through False River, across the inundated portion of Franks Tract and through the northern tip of Mandeville Island. The authorized channel would be 35 feet deep and 225 feet wide between confining levees, with widening to 250 feet in curves, and it would be 400 feet wide across the open portion of Franks Tract. The authorized modifications also include deepening the existing channel to 35 feet from Prisoners' Point to the eastern limits of the existing turning basin opposite the Port of Stockton. The Sacramento District, however, has eliminated the False River route and is currently improving the existing channel to authorized dimensions. Bank protection work was completed in 1972 along about 4,700 linear feet of levee at six sites bordering the channel from Venice Island to Stockton.

1.05 Division of Project Responsibilities. Project responsibilities are divided geographically between the San Francisco and Sacramento Districts of the Corps of Engineers. San Francisco District is responsible for planning engineering and construction of the San Francisco Bar Channel, the West Richmond Channel, the Pinole Shoal Channel, the Carquinez Strait Channel and a portion of the Suisun Bay Channel segments of the project. The upstream terminus of San Francisco District's projects is at Point Edith near the boundary line between the San Francisco and Sacramento Districts. The segments below Point Edith are collectively referred to as the John F. Baldwin Channel (PL 90-46, July 4, 1967). Sacramento District is responsible for design and construction of the segments upstream of Point Edith which are known as the Suisun Bay and Stockton Ship Channels.

1.06 Scope of Study. This study is limited to the evaluation of constructing the segment of the authorized project located in the Central San Francisco Bay referred to as Phase II of the Project. This segment, as authorized, includes deepening of the West Richmond Channel and Richmond Long Wharf Maneuvering Area. Project benefits for this segment are based on increased efficiency of transporting crude petroleum to the Richmond Long Wharf and adjacent refinery. These benefits would be realized independently of the disposition of remaining project segments. Although upstream benefits may occur as a result of deepening West Richmond Channel these benefits will not be addressed in this study. Design of the selected plan is developed to a level of detail sufficient to proceed with preparation of construction plans and specifications upon approval of this Interim Design Memorandum.

1.07 Study Process. Alternative plans are formulated in response to identified concerns, problems and opportunities in the study area. These plans are evaluated in terms of engineering, economic and environmental considerations. Viable plans are retained for further detailed evaluation. Public input is solicited and incorporated at appropriate points throughout the study process. Throughout the study, contact was maintained with representatives of Federal and State agencies and local interests with jurisdictional responsibilities or special concerns within the area under consideration. Federal agencies included the Environmental Protection Agency, Fish and Wildlife Service, National Marine Fisheries Service, Twelfth Coast Guard District, and Twelfth Naval District.

Agencies of the state of California that contributed to this study included the San Francisco Bay Conservation and Development Commission, Department of Fish and Game and San Francisco Bay Regional Water Quality Control Board. Numerous local interests also contributed including Contra Costa County, City of Richmond, Richmond Model Cities Economic Development Program Committee, Contra Costa County Development Association, San Francisco Bar Pilots, California Inland Pilots Association, Port of Richmond, Chevron and various other shipping companies.

1.08 Report Format. This report consists of a main report, Environmental Impact Statement and five appendices. The main report presents the study which resulted in selection of the plan recommended for construction. The appendices are detailed reports containing the technical information which supplement the study. The Draft Environmental Impact Statement focuses the study in the light of the National Environmental Policy Act.

SECTION 2

PROBLEM IDENTIFICATION

The problem identification task is undertaken to define the physical setting and the nature of water and related land resources management problems. The task culminates in the delineation of planning constraints and planning objectives specific to the study area which guide the formulation of alternative plans. The significant resources in the study area are also identified and form the basis for subsequent assessment of impacts of alternative plans.

2.01 National Objectives

Where a water and related land management project receives Federal assistance, it must address National Economic Development (NED) as the primary national objective. NED is achieved by increasing the value of the Nation's output of goods and services and/or improving the economic efficiency of producing these outputs. Although NED drives the project, Federal agencies are also directed to take into account the environmental impacts of the project and where possible, provide for the management, conservation, preservation, restoration, or improvement of the quality of natural and cultural resources within the project area. The NED planning objective is general and cannot be implemented directly. It can be achieved, however, by planning with objectives which reflect the opportunities and needs specific to the study area.

2.02 Study Area

The study area (see Figure 2) includes central San Francisco Bay from the Golden Gate Bridge in the west to the Oakland Bay Bridge in the south and to the Richmond - San Rafael Bridge in the north. Also included, but to a lesser level of detail are ocean areas outside the Golden Gate, nearshore land areas, an area north of the Richmond San Rafael Bridge which is a part of the authorized access route to the Richmond Long Wharf; and areas south of the Bay Bridge which are used by large vessels for anchorage and lightering operations.

The topography of adjacent land areas consists of hilly terrain used for a variety of purposes ranging from open space to densely populated metropolitan areas. Except for occasional fog, climate throughout the area permits year round efficient use of the navigation system. Winters are cool and rainy with periods of fog. Summers vary from warm and dry in the East Bay to cool and dry in the Golden Gate area. Annual precipitation consists almost entirely of winter rainfall which averages between 17 and 22 inches depending on location within the area. Waters of study area are oceanic. Tides during non-flood periods range from 5.8 to 0.0 MLLW at the Golden Gate and from 5.9 to 0.1 MLLW in Central San Francisco Bay.

Within the study area there are two major ports, Richmond and San Francisco. Several anchorage areas, and three deepwater navigation channels used for access to ports south of the Oakland Bay Bridge (Oakland, Alameda, Redwood City) and to inland ports north of the Richmond-San Rafael Bridge are intimately associated with the Study Area. The terminal facility most directly affected by this study is the Standard Oil Richmond Refinery which is owned and operated by Standard Oil Company of California, Western Operations,

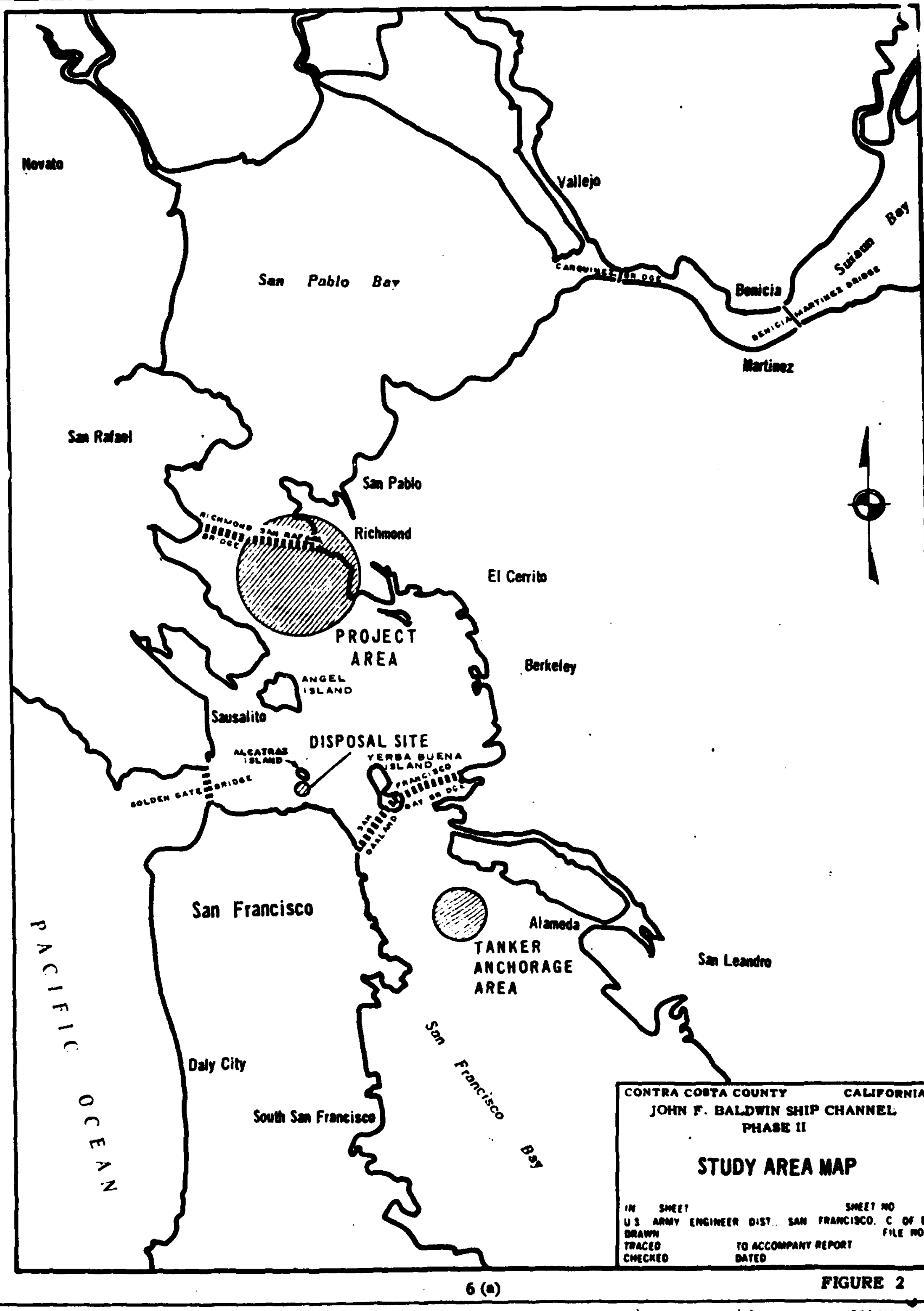

Novato
Vallejo
San Pablo Bay
Suisun Bay
Benicia
BENICIA MARTINEZ BRIDGE
Martinez
San Rafael
San Pablo
Richmond
El Cerrito
PROJECT AREA
Berkeley
ANGEL ISLAND
Sausalito
DISPOSAL SITE
ALCATRAZ ISLAND
YERBA BUENA ISLAND
GOLDEN GATE BRIDGE
San Francisco
PACIFIC OCEAN
Alameda
TANKER ANCHORAGE AREA
San Leandro
Daly City
South San Francisco
San Francisco Bay
CONTRA COSTA COUNTY CALIFORNIA
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
STUDY AREA MAP
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FIGURE 2

Inc. Other Standard Oil terminal facilities are located approximately 1.3 miles northeast of Point Richmond and south of the project area in Richmond Harbor.

Richmond Harbor is a Bay Area commercial port with petroleum and petroleum related products accounting for 75 percent of its total waterborne commerce. Tankers and containerships, as well as other craft, navigate through the in-bay shipping channels to reach Richmond. The nine-county Bay Area, is the second largest population center and marketing area on the Pacific Cost, and the seventh largest in the United States. International trade through the San Francisco Customs District has made the District the third largest on the West Coast. Most of the crude petroleum transported to Richmond is handled at Richmond Long Wharf which is operated by the Standard Oil Company. Sports such as fishing and boating afforded by the Bay, are of minor importance in the port area.

The shipping lane through the authorized West Richmond Channel and the Southampton Shoal Connecting Channel are in-bay shipping channels located west of Richmond Harbor. The Harbor is situated on the eastern side of San Francisco Bay, approximately 14 miles northeast of the Golden Gate Bridge. The West Richmond Channel extends for about 3 miles from deep water in central San Francisco Bay through the west navigation opening of the Richmond-San Rafael Bridge and into the deep water of San Pablo Strait just upstream of the bridge. Parallel and to the east of the lower end of West Richmond Channel is the Southampton Shoal Channel which provides a direct access to Richmond Harbor and the maneuvering area at the Richmond Long Wharf.

The maneuvering area adjacent to the Long Wharf is approximately 2,500 feet long alongside the face of the wharf and 2,000 feet across (perpendicular to the wharf) with depths ranging between 35 and 38 feet below MLLW. Maintenance dredging to -35 feet MLLW by the Corps of Engineers is authorized. Aids to navigation include lights at six locations at or near the perimeter of the maneuvering area. Access to the maneuvering area from the south is via the Southampton Channel and from the north through naturally deep water under the East Navigation opening of the Richmond-San Rafael Bridge.

2.03 Public Concerns

Concerns are public perceptions and desires which may be expressed directly, such as through correspondence or at public meetings, or indirectly through government representatives and agencies. Several concerns have been expressed by users regarding navigational difficulties associated with access to the Richmond Long Wharf Maneuvering Area. These concerns are summarized in the following paragraphs. Other concerns summarized below are those embodied in environmental legislation.

a. Navigational Efficiency. Tank vessel operators have stated that inefficient oil delivery methods are used due to insufficient depths to and in Long Wharf Maneuvering Area. Small or "light-loaded" vessels are often used for crude petroleum delivery to the Richmond refinery in order to gain access to the maneuvering area. This results in the need for a larger number of trips and a larger unit cost per barrel of oil delivered. Under current shipping operations, fully loaded large vessels drop off part of their load at Standard Oil's refinery at El Segundo in Southern California before proceeding on to Richmond or enter the San Francisco Bay fully loaded and wait at deep anchorage while lightering vessels transfer the product to the refinery.

Lightering operations are more time consuming and expensive than direct deliveries. The concern for navigational inefficiencies is reflected in the Congressional authorization for construction of deeper channels contained in Public Law 89-298.

b. Navigational Safety. Vessel and tugboat pilots have reported near-accidents resulting from the extremely sharp right turn made by vessels entering the maneuvering area via the southerly approach (Southampton Channel). Vessel handling is reportedly made difficult by the combination of cross-currents and slow-speeds necessary to make the turn. Other safety concerns voiced by the pilots relate to the difficulty of entering the maneuvering area from the north under ebb-tide conditions. The northerly approach involves transit through a narrow channel between Castro Rocks to port and the Richmond-San Rafael Bridge pier to starboard. The pilots do not attempt transit during periods which contribute to poor vessel controllability such as whenever the vessel must travel in the same direction as the current (ebb tide). Another safety consideration cited by pilots concerns vertical clearance under the east span of the Richmond-San Rafael Bridge. Pilots state that many large vessels are unable to clear the 135-foot (above mean higher high water) span.

c. Endangered and Threatened Species. The public concern for the preservation and protection of endangered and threatened species is reflected in the Federal Endangered Species Act of 1973.

d. Water Quality. The public concern for maintaining and enhancing water quality is reflected in the Clean Water Act of 1977, as amended. The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters.

e. Wetlands. The public concern for maintaining and enhancing wetlands is reflected in Executive Order 11990 (Wetlands Protection). This policy states that Federal agencies should avoid to the maximum extent possible the long and short term adverse impacts associated with destruction or modification of wetlands. This public concern is reinforced by the Chief of Engineers Wetlands Policy and the State of California Wetlands Policy.

f. Ocean Environment. Public concern for the maintenance of a stable ocean environment is reflected in the Marine Protection, Research and Sanctuaries Act of 1972. This Act regulates the dumping and transportation for dumping of waste materials in the ocean so that no unreasonable degradation or endangerment shall occur to human health, welfare or amenities of the marine environment, ecological system and economic potentialities.

g. Inland Waters Environment. Public concern for protection of inland waters from the effects of disposal of waste materials is reflected in Section 404(b) of the Clean Water Act of 1977. This section mandates physical, chemical and biological evaluation of the waste materials and of the receiving inland waterways in order to minimize degradation of water quality and endangerment of ecological habitats.

2.04 Problems and Opportunities

Many of the public concerns are directly related to physical problems that can be solved through water and related land resources management. While the evaluation of public concerns reflects the range of needs perceived by the public, the problems, and opportunities addressed in the following paragraphs are established on the basis of technical and professional analysis.

a. Navigation Efficiency. Current fleet operations include the direct shipment petroleum from Alaska to the Richmond Long Wharf with 80,000 DWT and 120,000 DWT tankers with lightering in San Francisco Bay. Current shipments of Indonesian petroleum are through El Segundo utilizing 150,000 DWT tankers with lightering in San Francisco Bay. The extensive use of lightering vessels for delivering petroleum from Anchorage Nine in the South Bay to the Richmond Long Wharf represents an economic inefficiency.

To analyse the economic impacts of channel deepening, an idealized fleet composition was determined by minimizing transportation costs as explained in Appendix A. An assumed ideal fleet composition for the existing channel configuration is used for economic evaluation rather than the actual fleet composition since it then can be compared to an idealized fleet composition which would result from an improved navigation channel. The idealized fleet composition for the existing channel configuration is shown below:

Vessel Size (DWT)	SOURCE	ROUTE
140,000 with 2 Lightering Vessels	Alaska	Direct
150,000 with 2 Lightering vessels	Indonesia	Indirect via El Segundo

This is very similar to the current fleet operations with the exception that 120,000 and 80,000 DWTs are used from Alaska. This supports the idea that shippers do attempt to use the most efficient vessels given the constraints imposed by any particular route. Differences between the actual and the idealized fleet composition are largely attributable to differences betw the company's true operating costs and the operating cost data prepared on nationwide basis 1/, especially differences in the costs associated with lightering. In San Francisco Bay lightering is primarily the result of inadequate in-bay channel depths. If for example, the cost for the lightering vessels in the nationwide data were increased in the economic analysis, there would be a tendency to reduce the amount of lightering by employing smaller primary tankers. This tendency appears to be reflected in the actual fleet carrying petroleum from Alaska. Other reasons exist for the variation between actual and the assumed "ideal fleets" such as timing, current ship availabilty and the cost of investment. These reasons are discussed in Appendix A, Economic Evaluation.

b. Navigation Safety. Tidal currents at the northern end of the maneuvering area average 1.3 knots at maximum flood and 1.4 knots at maximum ebb, while the tropic (average monthly maximum) values are 1.9 knots and 2.4 knots, respectively.

1/ Estimated Annual U.S. and Foreign Flag Deep Draft Vessel Operating Cost, U.S. Army Water Resources Support Center, Corps of Engineers, July 1981.

Current directions are 320° (flood) and 175° (ebb) from true North (0°). These conditions coupled with orientation of the Richmond Long Wharf make navigation by large tank vessels from the southerly approach difficult. The northerly approach to the Richmond Long Wharf (from the West Richmond Channel) has the problems of clearance under the east navigation opening of the Richmond San Rafael Bridge and vessel controllability under ebb tide conditions. A survey of mast heights of tank vessels calling at the Richmond Long Wharf shows that most vessels larger than 100,000 DW· are unable to clear the 135' vertical clearance height of the east navigation opening. Vessels which are able to clear the bridge, experience difficult control problems during an ebb tide because a following current is pushing them at a time when they must slow down and turn to Long Wharf. This situation has prompted Standard Oil to prohibit the use of the northerly approach by Chevron ships during ebb tides.

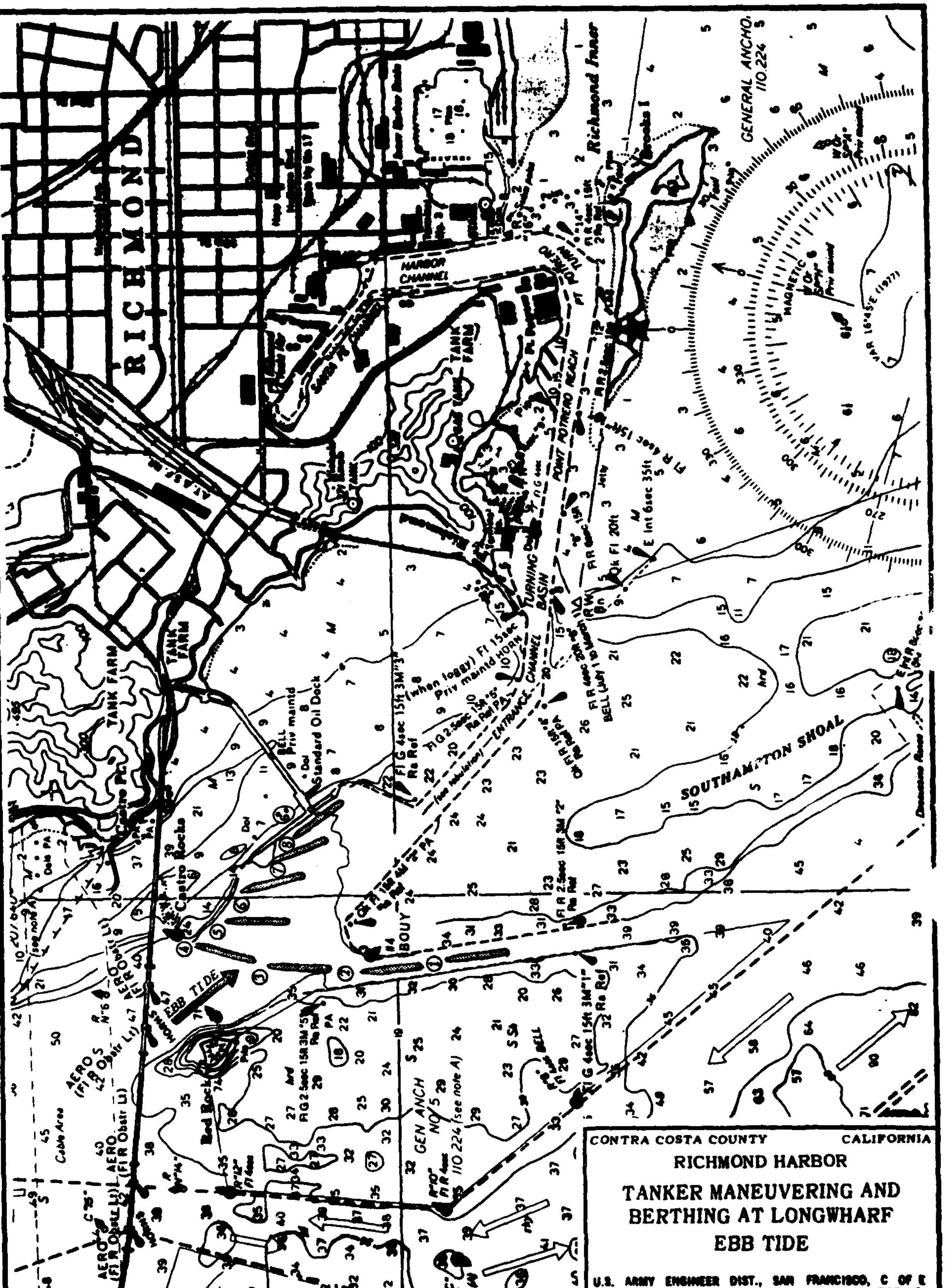
Most pilots consider the southerly approach (from the Southampton Channel) to be the safest route to the Long Wharf and Richmond Harbor under all conditions. This route, however, is not without its problems. Special maneuvering and berthing procedures are required for ships to reach the Richmond Long Wharf. These procedures are shown on Figures 3 and 4. Particularly troublesome, is the berthing maneuver during flood tide. The orientation of the Southampton Channel is approximately 173° clockwise from true North while the orientation of the Long Wharf is 145° clockwise from true North. A vessel attempting to berth during a flood tide therefore, must make a relatively sharp turn (152°) across the manuevering area to come in line with the Long Wharf.

c. Other Port of Richmond Traffic. In addition to Richmond Long Wharf traffic, the Maneuvering Area and access channels are used by commercial vessels and pleasure craft in transit to and from Richmond Harbor. The Port of Richmond has terminal facilities south of the Long Wharf for break bulk, container, dry bulk and liquid bulk cargo. Local plans exist for improving railroad and highway access to the port and for increasing container storage capacity and number of containership berths. A Corps of Engineers Feasibility Report[2/] recommends deepening the harbor and access channels to 41 ft. MLLW from the existing 35-foot depth. Deepening the channel and harbor would result in economies of scale accruing to existing traffic and would also stimulate future traffic and permit the realization of port development plans. Improvements made as a part of this John F. Baldwin project would result in partial implementation of improvements recommended in the Richmond Harbor Feasibility Report.

2.05 Environmental Considerations

This subsection outlines some of the environmental considerations which are taken into account in planning the project. The resources described are considered important because they are identified in laws, regulations, guidelines, or other institutional standards of national, regional, local, public or private agencies. Navigation efficiency and safety considerations have been discussed previously. Environmental considerations in the study area include:

2/ Richmond Harbor California, Deep Draft Navigation Improvements, Feasibility Report, Corps of Engineers, San Francisco District, September 1981.



CONTRA COSTA COUNTY CALIFORNIA

RICHMOND HARBOR

TANKER MANEUVERING AND BERTHING AT LONGWHARF

EBB TIDE

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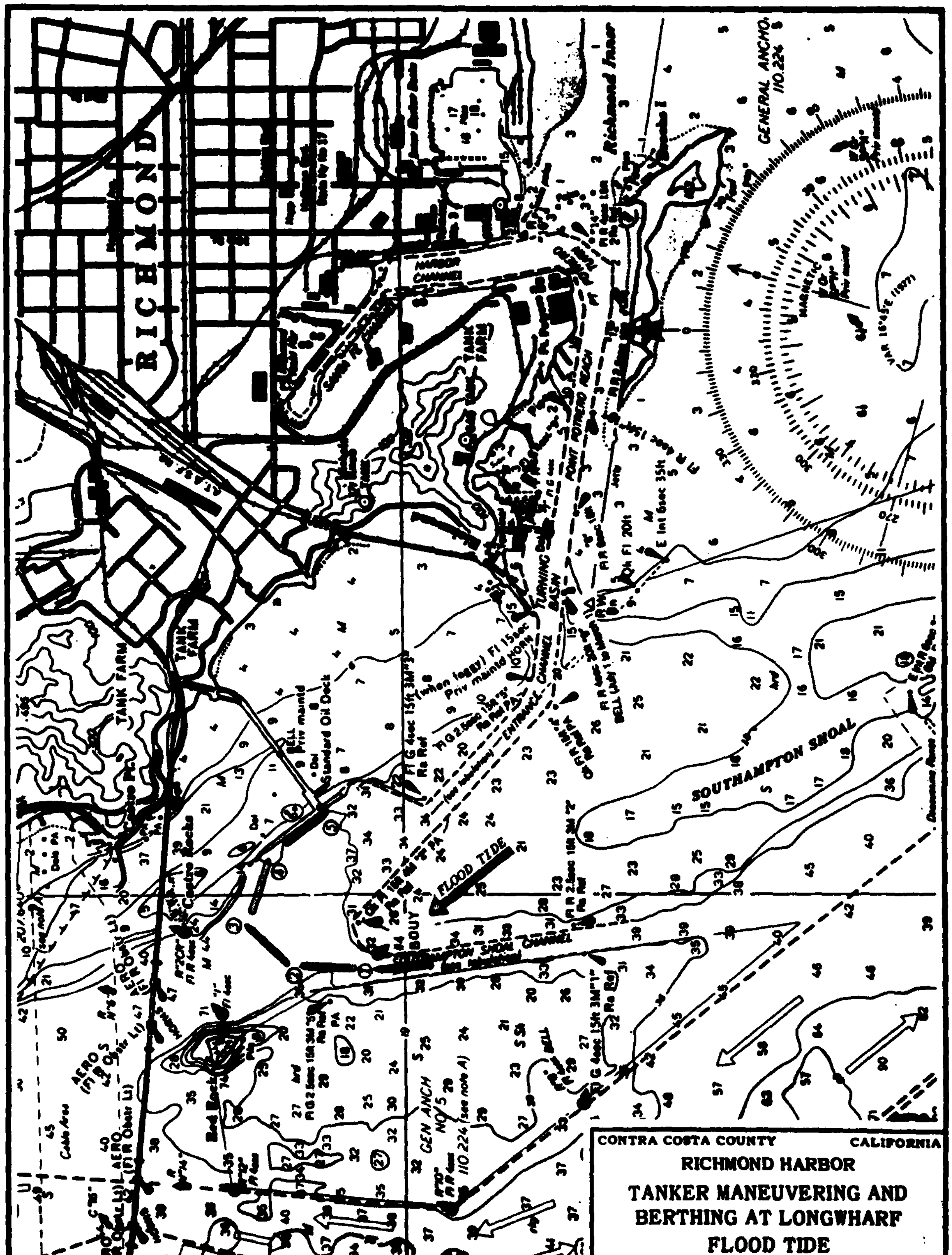
FIGURE 3



CONTRA COSTA COUNTY CALIFORNIA

RICHMOND HARBOR

TANKER MANEUVERING AND BERTHING AT LONGWHARF FLOOD TIDE

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
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CHECKED: DATED

F'''JR 4

a. Endangered and Threatened Species. Nine endangered or rare animal species or sub-species may be found in the San Francisco Bay Area. None of these species are known to inhabit the Richmond Harbor area. No endangered or threatened plant species are known to be found in the area. (See Appendix C, Fish and Wildlife Coordination)

b. Air Quality. In 1981 the San Francisco District performed an air quality analysis for the Richmond Harbor (including the Richmond Long Wharf) when considering deep-draft navigation improvements for that area 3/. This analysis showed that air quality in Richmond generally is "good", and that while dredging would have a short-term impact on air quality conditions, no significant changes in future air quality conditions were identified with or without the project.

c. Water Quality. Water Quality is a significant resource based on the concerns of the Clean Water Act (CWA) as amended in 1977 and the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972., Water quality parameters are directly related to the interaction of sediment and water at the dredging and disposal sites under consideration. Water quality parameters of concern include: dissolved oxygen concentrations, suspended solids, heavy metals, petroleum hydrocarbons, and pesticides.

Sediment quality analyses, bioassays and bio-accumulation studies showed that bottom materials from the West Richmond and Southampton Shoal Channel consisted primarily of sands and are therefore considered inert. (See Appendix B for Analysis of Sediments)

The bottom material from the Maneuvering Area contain a greater proportion of silt and therefore were tested to determine their disposition in the biological community during dredging and disposal. The result of the bioassay concluded that fish would not be exposed to concentrations of dredged material great enough to cause significant mortality due to any biologically active constituent. The bio-accumulation results revealed no significant uptake of cadmium, copper, lead, mercury, zinc, chlorinated hydrocarbons, petroleum hydrocarbons and polychlorobiphenyls by the test species, Japanese littleneck clam. (See Appendix B for bio-accumulation report)

d. Wetlands and Intertidal Areas. Existing wetlands in or near the study area occur at Emeryville, Point Isabel, Brooks Island and North Richmond. Both Federal and State policies declare wetlands to be vital areas constituting productive and valuable public resources and discourage, as contrary to the public interest, their alteration or destruction.

Intertidal flats rim most of San Francisco Bay. In the study area important intertidal areas exist along east shore Emeryville, Richmond and Brooks Island. Intertidal flats support diverse invertebrate faunal assemblages which provide nursery and feeding areas for a variety of shorebirds, waterfowl and fish including a number of game species. Although intertidal areas are not vegetated, they essentially hold the same public resource values as vegetated, wetlands. No wetland or intertidal areas will be directly impacted by any project alternative.

3/ Richmond Harbor Feasibility Report, Appendix K, Corps of Engineers, San Francisco District, 1981.

e. Benthos. This subtidal resource is considered significant because of its role in the aquatic food web. Both alternative channel areas and the general area of the disposal site contain this resource and all would be directly impacted. This resource consists primarily of invertebrate organisms including worms, crustaceans, and assorted mollusks. These small bottom-dwellers are food for larger vertebrates aquatic life. Several areas adjacent the Richmond Harbor area are considered potential shellfish seeding areas. With annual maintenace dredging of existing channels, community stability of benthic life is limited. Shoaling of excavated channel bottoms also contributes to an unstable community in the channel bottom. Studies [4/] conducted throughout the Bay specifically for dredging and disposal activities, have shown that recolonization occurs in the dredged areas. This recolonization indicates the resiliency of the benthos to re-establish after disturbance.

f. Energy. Related to efficient use of the navigation channels by commercial vessels is energy consumption. Energy resources have assumed greater economic and environmental values due to increasing demand and higher costs. The present national concern for conservation of energy resources has application to efficient navigation use and is treated as a significant resource. The measurement of this resource can be indicated by savings realized from the reduction of tidal delays and lightering activities, a part of the commercial shipping benefits.

2.06 Planning Objectives

Improvements in navigation supported by Federal funding must be in the Federal interest and must be accessible to all users on equal terms. Since this project serves one user, the problem of equal access does not occur. However, the improvements must contribute to the overall national objective of Federally funded water and related land resources planning; namely: National Economic Development (NED). This national objective establishes the framework for planning a Federal water resources development project. Planning objectives derived through analysis of public concerns and significant resources of a specific study area, are set within this framework and form the basis of the study. Concern has been expressed during the conduct of this study for the improvement of efficiency (and safety) of waterborne transportation of crude petroleum in Central San Francisco Bay. Technical investigations and analysis indicate that existing channel depths limit the size of crude petroleum loads which can be safely transported to a major oil terminal in the Central Bay, which results in economically inefficient shipping procedures of Federal concern.

As a result of the analysis of the public concerns and problems and opportunities of this study area, the following planning objectives are derived and employed in the plan formulation section:

4/ Dredge Disposal Study - San Francisco Bay and Estuary, Corps of Engineers, San Francisco District, February 1977.

Navigation Efficiency.

To improve the efficiency of navigation of Central San Fancisco Bay in the transportation of foreign and interstate crude petroleum for the period 1985 to 2035 is the first objective.

Navigation Safety.

To improve the safety margin for navigation of tanker vessel traffic using Central San Francsico Bay for the period 1985 to 2035 is the second objective.

2.07 Planning Constraints

Planning constraints are overriding concerns that must be considered in the development of plans. Planning constraints reflect the combination of expressed public concerns and the actual existence of a significant resource related to that concern. Planning constraints may not be bartered or exchanged in the planning effort. The planning constraints for this study are:

a. Wetlands. There is a need to avoid adverse impacts on wetlands to comply with Executive Order 11990, Protection of the Wetlands. This Order directs Federal agencies to provide leadership, to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. This policy states that agencies should avoid to the extent possible the long and short-term impacts associated with modification or destruction of wetlands. The agency shall also avoid undertaking and providing support for new construction, including dredging, channelizing, filling, diking, impounding and related activities located in wetlands, unless the agency head finds: (1) no practical alternative and (2) all practical measures have been taken into account including economic, environmental and other pertinent factors. Wetland areas exist within the San Francisco Bay Area. Because of this constraint, no project actions were considered which would impact wetlands.

b. Dredge Material Disposal. The need for the proposed dredging and acceptable disposal activities are established. Land disposal sites were eliminated due to lack of available area in nearby locations. As a result, only aquatic disposal of dredged material is considered in this study.

The discharge of dredged or fill material into waters of the United States requires compliance with the Environmental Protection Agency's interim final guidelines (40 CFR 230.4 and 230.5), which regulate all discharges of dredged or fill material under Section 404 of the Clean Water Act. These "404b guidelines" provide a general approach for EPA and the Corps of Engineers to evaluate discharges of dredged or fill material. The procedures used by the San Francisco District under 404b to determine the suitability of dredged material for aquatic disposal are contained in Public Notice No. 78-1 (See Appendix B) issued by the District Engineer on 30 July 1979. These procedures are used in conjunction with EPA's 1975 guidelines (40 CFR 230 and the Corps regulations 33 CFR 320-329, 19 July 1977), to evaluate potential aquatic impacts of discharges at open-water sites within the District.

Public Notice 78-1 specifies procedures for evaluating the discharge of silt dredged material by elutriate analysis of the dredged material mixed with the disposal site water. The elutriate data is then compared to established water quality objective after dilution within the permissible mixing zone of the disposal area has been taken into account. If the concentration of one or more of the contaminants would exceed the water quality objective after dilution, a suspended particulate phase bioassay is required to determine actual impact. Otherwise the dredge material is considered suitable for aquatic disposal without further testing.

Because of this constraint extensive sediment quality testing was required for in-bay disposal. (See Appendix B for 404b Evaluation)

SECTION 3

PLAN FORMULATION

Plan formulation, the heart of the planning process, consists of the development of resource management measures which could be used to address the planning objectives identified in the preceding chapter, Problem Identification. Plan formulation develops a range of possible management measures; conducts a preliminary assessment of the impacts of these measures; screens out various measures on the basis of an evaluation of their impacts; and combines the remaining measures into detailed plans for further evaluation. The candidate plans which are the outputs of plan formulation are described at the end of this Chapter.

3.01 Alternative Management Measures

Water and related land resources may be managed by a wide variety of technical and institutional means. Several management measures could be used to address the specified planning objectives. A range of management measures are examined to identify those which, alone or in combination, could address one or more of the planning objectives. These management measures are the "building blocks" or plan components which can subsequently be developed into alternative plans. All appropriate measures are identified including those proposed or suggested by different interest groups. The types of management measures which could be employed are described in the following paragraphs. The advantages and disadvantages of each are also discussed.

a. No Federal Action. This alternative assumes that no new project would be built to facilitate the transportation of crude petroleum to the Richmond Long Wharf. Large Standard Oil tankers would continue to navigate from deep-water in San Francisco Bay to lightering areas in the South Bay and would then reach the Long Wharf via Southampton Shoal Channel. Existing ship channels and maneuvering areas would continue to be maintained at existing -35 feet (MLLW) depths. Refinery through-put, over the next 50 years, would be as shown on Table 2 below.

TABLE 2

ACTUAL & PROJECTED CRUDE OIL DELIVERIES
RICHMOND
Barrels/Calender Day

	1981	1985	1995	2005-35
Alaskan	120,000	122,400	128,600	135,000
Indonesian	25,000	25,500	26,800	28,000
Domestic	136,000*	136,000	136,000	131,000
Total Production	281,000	284,000	291,000	294,000
Capacity	294,000**	294,000**	294,000**	294,000**

* Estero mix - 24,000; Pipeline - 112,000; total expected to ultimately travel entirely by pipeline.

** Actual capacity is 365,000 but held to 294,000 because of Air Control Board restrictions.

Source: Industry spokesmen.

Petroleum demand projections are assumed to be independent of the refinery's ability to transport petroleum efficiently and would be realized irrespective of the alternative selected.

b. Central Terminal near Treasure Island.[5/] This alternative would entail construction of fixed berths west of Treasure Island, with pumping equipment and underwater pipelines for transportation of petroleum to storage tanks at the Richmond refinery (see Figure 5). The first costs of berthing structures sufficiently large to accommodate tankers up to the size which can navigate the San Francisco Bar at existing depths, exclusive of pipelines, and pumps, is estimated at $790 million. This estimated cost exceeds the costs for the dredging alternatives by a substantial amount. There is no indication of support for this alternative by the potential users and there are no obvious environmental advantages which would result from its implementation.

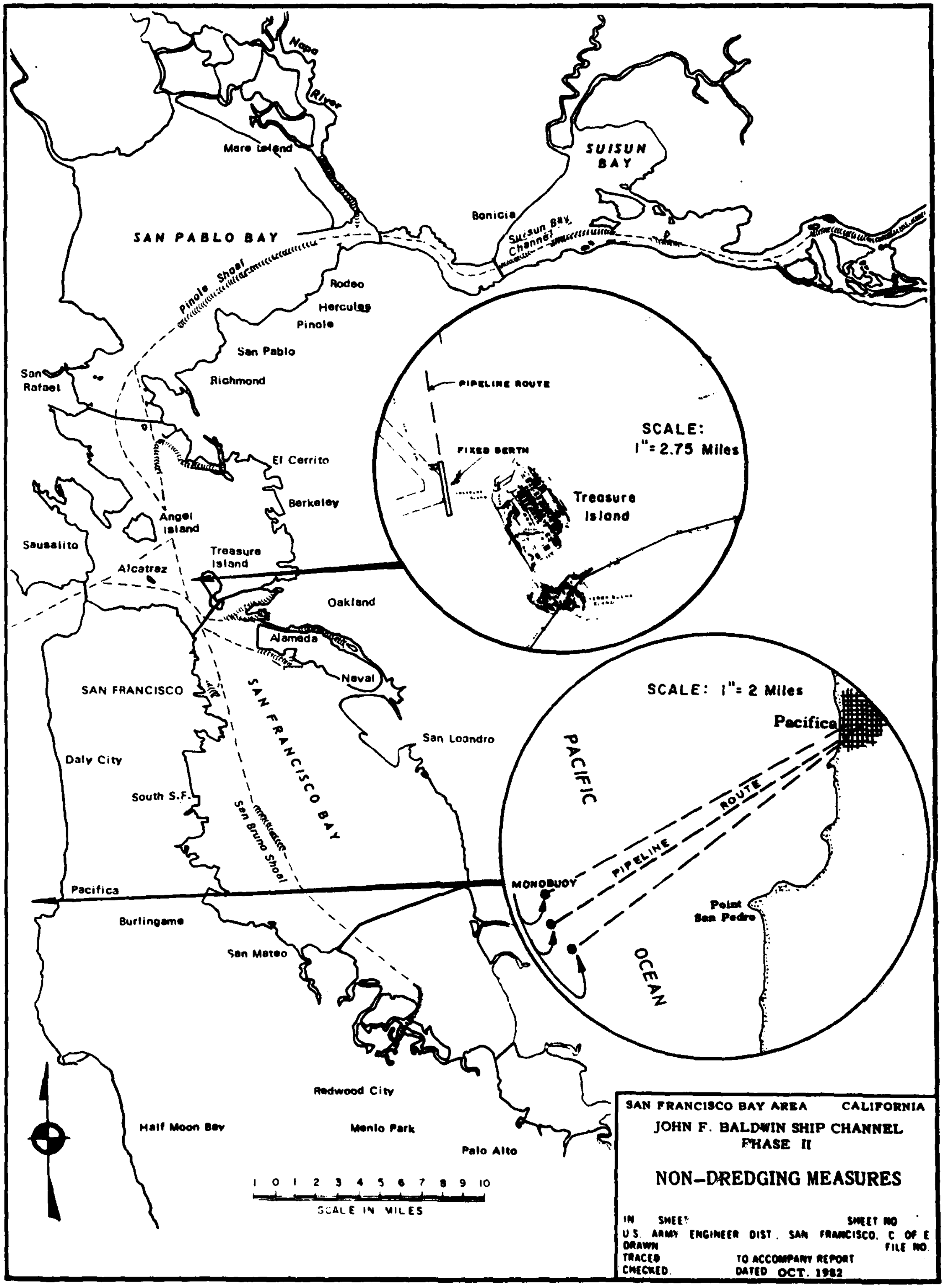
c. Monobuoy Off Golden Gate/Pacifica.[5/] This alternative consists of monobuoys anchored in deepwater approximately three miles offshore of Pacifica, California where tankers of any size could be accommodated (see Figure 5). The crude oil would be conveyed to a storage facility in the City of Pacifica by pipelines. From this storage facility, oil would be pumped to Richmond and to other refineries in Contra Costa and Solano Counties. The cost of a monobuoy to accommodate 250,000 DWT tankers (chosen as a representative large vessel) is estimated at $1.4 billion, exclusive of storage facilities and the work required to transfer the oil to Contra Costa County.

This partial cost easily exceeds the total estimated cost of the dredging alternatives. There is no indication of support for this alternative by the potential users and there are no obvious environmental advantages which would result from its implementation.

d. West Richmond Channel (WRC) Dredging. The West Richmond Channel between Black and White Buoy "C" and deep water north of the Richmond-San Rafael Bridge and the Richmond Long Wharf Maneuvering Area would be dredged to -45 MLLW as authorized in 1965. Vessels bound for the Richmond Long Wharf would proceed north through the channel and under the west navigation opening of the Richmond-San Rafael Bridge, then make a U-turn to starboard and return under the east navigation opening of the bridge to enter the Maneuvering Area (See Figure 6).

There are two major drawbacks to this alternative. First, there is the matter of hazards to navigation, namely the bridge and rocks (Castro Rocks and Red Rock) which become especially prominent when navigation is attempted during ebb tide. Reduced vessel maneuverability on ebb tide approaching the east navigation opening of the bridge could result in a major accident involving the bridge or rocks. The second drawback is the clearance under the east span of the bridge, the height of which is limited to 135 feet above mean higher high water. Vessels of the 100,000 DTW and larger class can not clear the bridge at high tide. If under this alternative larger vessels could not use

5/ West Coast Deepwater Port Study, North Pacific Division/South Pacific Division , Corps of Engineers, 1976.



SAN FRANCISCO BAY AREA CALIFORNIA

JOHN F. BALDWIN SHIP CHANNEL
PHASE II

NON-DREDGING MEASURES

IN SHEET SHEET NO
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FIGURE 5

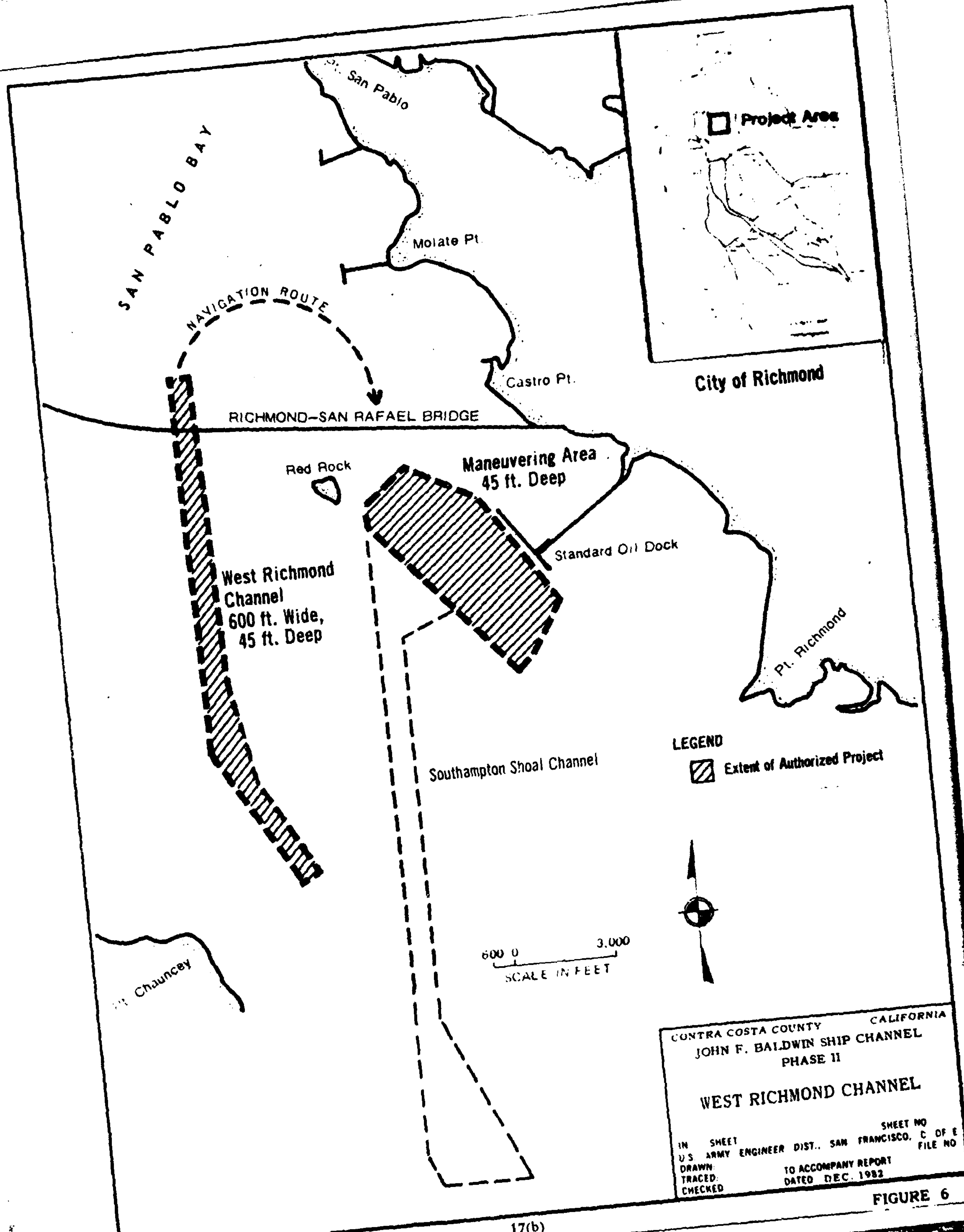
Pt. San Pablo
SAN PABLO BAY
Molate Pt.
NAVIGATION ROUTE
Castro Pt.
Project Area
City of Richmond
RICHMOND–SAN RAFAEL BRIDGE
Red Rock
Maneuvering Area
45 ft. Deep
Standard Oil Dock
West Richmond
Channel
600 ft. Wide,
45 ft. Deep
Pt. Richmond
LEGEND
Extent of Authorized Project
Southampton Shoal Channel
600 0 3,000
SCALE IN FEET
Pt. Chauncey
CONTRA COSTA COUNTY CALIFORNIA
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
WEST RICHMOND CHANNEL
IN SHEET SHEET NO
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E FILE NO
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FIGURE 6

the route because of bridge height limitations, and all other vessels would not use the route during ebb tide because of navigation risks, the actual benefits associated with access to the Richmond Long Wharf of a deepened West Richmond Channel would be negligible.

e. Southampton Shoal Channel (SSC) Dredging. By this measure (see figure 6) the Southampton Shoal Channel and Richmond Long Wharf Maneuvering Area, which are currently maintained at -35 feet MLLW would be dredged to a depth of -45 feet MLLW. The Southampton Shoal Channel is the preferred route by users for access to the Richmond Long Wharf, because it is a more direct and less hazardous route than the West Richmond Channel. Dredging the Southampton Channel, however, is a larger job than dredging the West Richmond Channel. Increased dredging quantities are due to the flaring of the channel ends and the fact that there are no naturally deep areas in the channel.

3.02 The four management measures discussed above were screened by applying the four tests of: functional effectiveness, public acceptability, economic efficiency and completeness. The summary of this first screening process is shown on Table 3 below. The No-Action measure is not included in this initial screening because it is always considered a viable measure and should be considered through-out the study process. As a result of this screening process the Treasure Island Terminal and Ocean Monobuoy management measures are dropped from further consideration in this study, on the basis of high costs, large scope of impacts and no local support. The West Richmond Channel dredging is also dropped from further consideration because it does not meet the planning objectives and it is not supported by the Richmond Harbor users. Dredging the Southampton Shoal Channel appears to be the only alternative to pass the four tests and therefore it is carried forward along with the no-action alternative for further analysis.

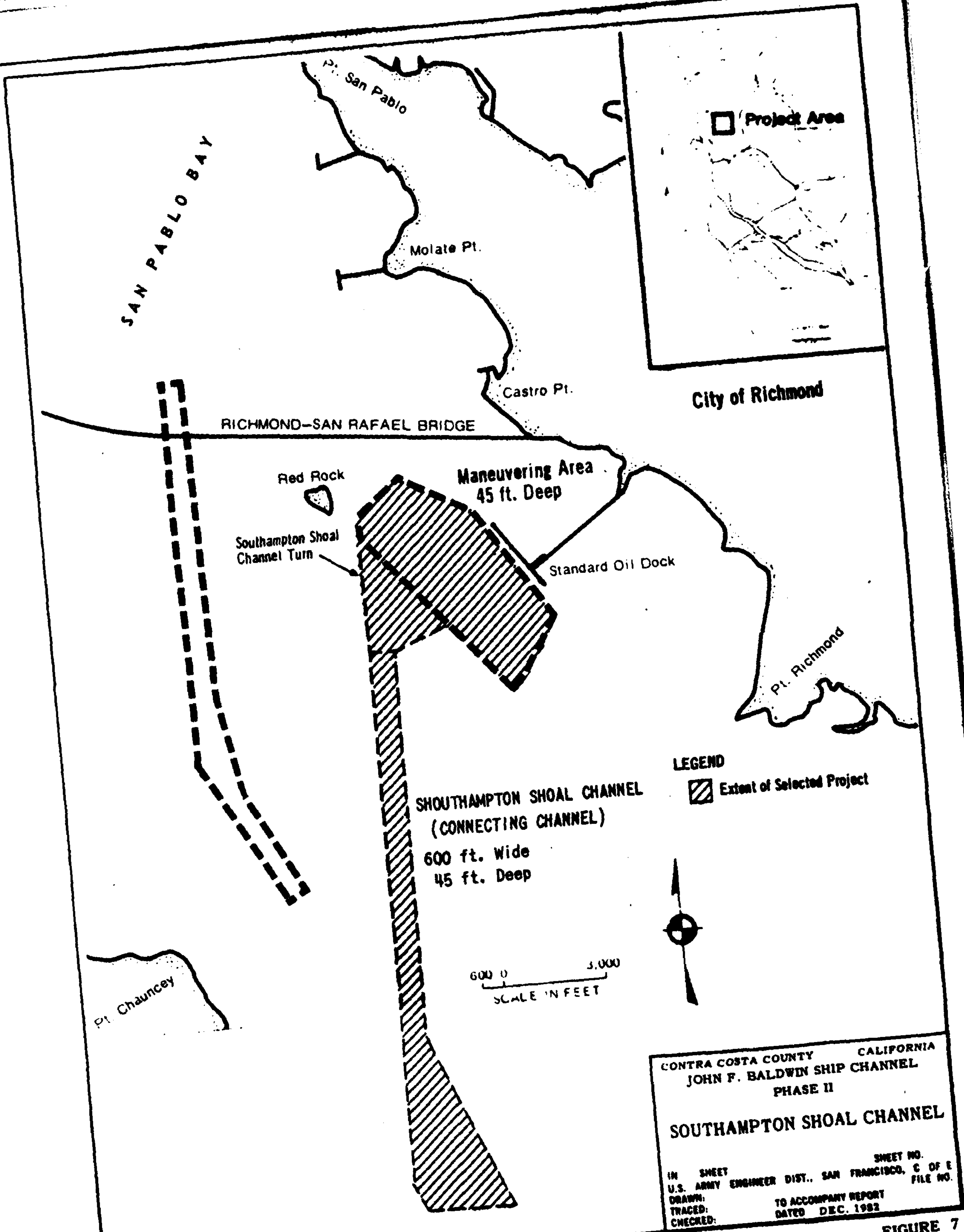
Pt. San Pablo
SAN PABLO BAY
Molate Pt.
Project Area
Castro Pt.
City of Richmond
RICHMOND–SAN RAFAEL BRIDGE
Red Rock
Maneuvering Area
45 ft. Deep
Southampton Shoal
Channel Turn
Standard Oil Dock
Pt. Richmond
LEGEND
Extent of Selected Project
SHOUTHAMPTON SHOAL CHANNEL
(CONNECTING CHANNEL)
600 ft. Wide
45 ft. Deep
600 0 3,000
SCALE IN FEET
Pt. Chauncey
CONTRA COSTA COUNTY CALIFORNIA
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
SOUTHAMPTON SHOAL CHANNEL
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
TO ACCOMPANY REPORT
DATED DEC. 1982

FIGURE 7

TABLE 3
SCREENING OF MANAGEMENT MEASURES

MGT MEASURE TEST	TI TERMINAL	OCEAN MONOBUOY	WRC DREDGING	SSC DREDGING
FUNCTIONAL EFFECTIVENESS	Provides deepdraft facilities. Requires additional trans. facilities	Provides deepdraft facilities. Requires additional trans. facilities	Provides limited deepdraft access to existing facilities	Provides deep-draft access to existing facilities
PUBLIC ACCEPTABILITY	Land and water impact: No Local Support	Land and water impact: No Local Support	Water quality impacts, Partial local support	Water quality impacts, Local Support
ECONOMIC EFFICIENCY	Cost $790M	Cost $1390M	Cost $30M	Cost $43M
COMPLETENESS	Meets planning objectives but	Meets planning objectives	Does not meet objectives	Meets planning objectives

3.03 Dredging and Disposal Management Measures. The assumed dredging and disposal method is clamshell and barge with disposal at the Alcatraz Disposal Site SF 11. The Alcatraz site (Figure 8) is located in an open-water high energy area about one-third of a mile south of Alcatraz Island. Recent hydrographic surveys of the site indicate a mound raising from about -80 feet MLLW to -25 feet in the eastern half of the site, covering about 25 percent of the area. At present no disposal is permitted in the eastern half of the site and disposal in the western half is limited to sediments free of debris.

Hydraulic/barge or hopper dredging, with disposal at Alcatraz, can also be considered possible dredging methods, but it is not known at this time how commercial dredging contractors will bid the work. Other dredging and disposal methods considered but eliminated om further study are as follows: (see paragraphs 3.04 Page EIS-9 for discussion)

Method	Reason for Elimination
1. Hydraulic dredging with land disposal	No acceptable land disposal sites within the study area.
2. Hydraulic dredging with pipeline aquatic disposal	Difficulties in locating a long disposal pipeline in an active open-water environment and heavy use navigation area.
3. Ocean Disposal	Transportation costs and the requirement for permanent disposal site designation.
4. Other in-bay disposal	Transportation costs and greater potential for environmental impacts.

ALCATRAZ DISPOSAL SITE
9 JAN 1983

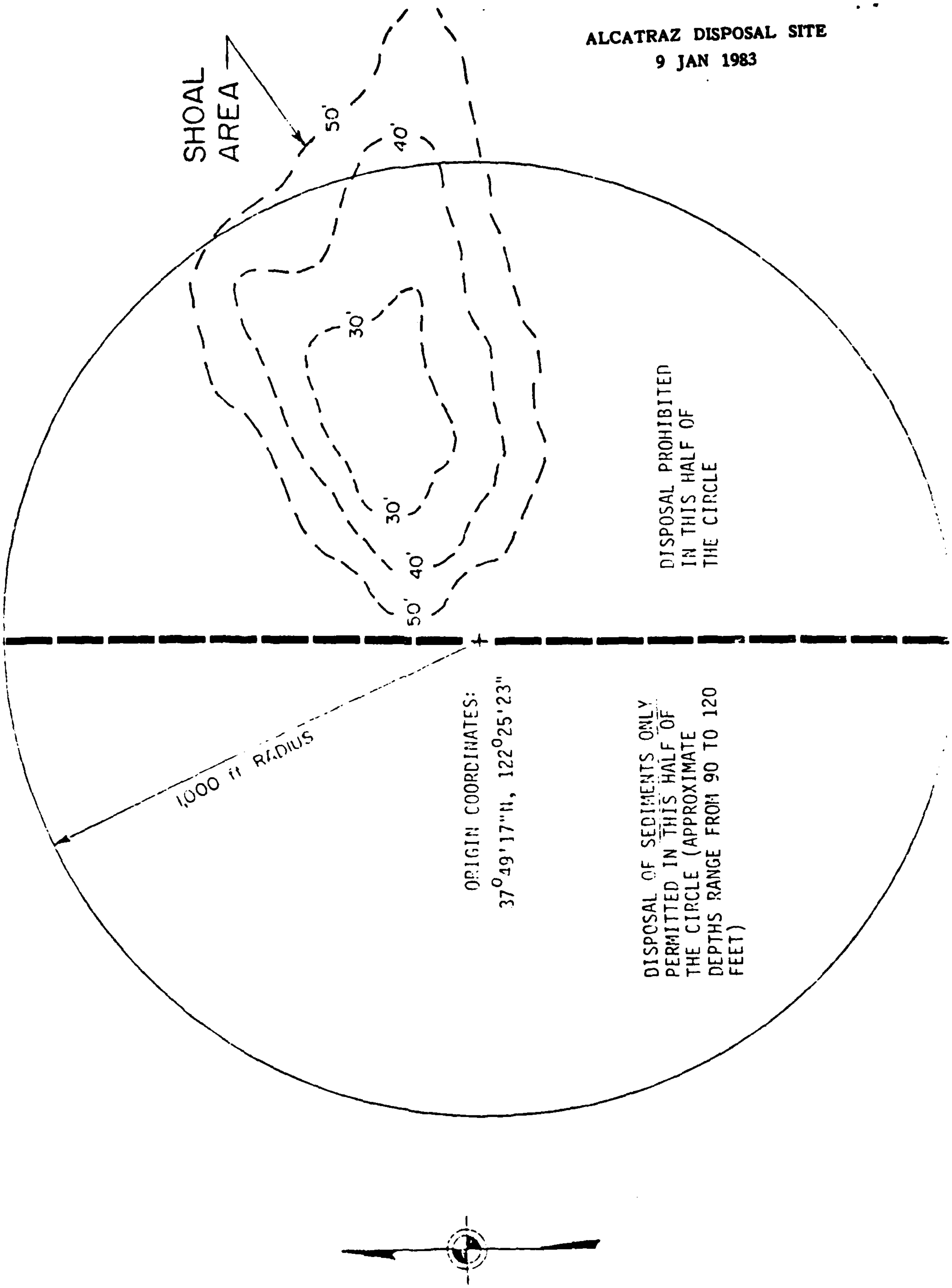

FIGURE 8

3.04 Detailed Plans

Plans consist of one or more management measures combined to address the established planning objectives. Measures which survived the screening process described in the previous section are combined into detailed plans. The following paragraphs present a description of detailed plans formulated for evaluation.

a. Plan 1: No Federal Project. Under "no action", existing channels and maneuvering areas would be maintained at present depths. The Southampton Channel is more or less self-flushing as a result of its orientation parallel to prevailing currents. Annual maintenance dredging of the Southampton Shoal Channel is estimated at 12,000 cy per year. The Maneuvering Area requires periodic maintenance by the Corps of Engineers to maintain its -35 ft. MLLW authorized depth. The 25-year maintenance record for the Maneuvering Area shows that an average of 70,000 cy of material are removed annually. However, the actual dredging of the Maneuvering Area is highly variable in terms of quantity and schedule. It is expected that there would be no changes in the maintenance dredging quantities of the existing project in the future.

b. Plan 2: Deepening Southampton Channel and Richmond Long Wharf Maneuvering Area - Dredged Material Disposal at Alcatraz. The Richmond Long Wharf Maneuvering Area and the Southampton Channel would be dredged to a depth of -45 feet MLLW. The width of the channel would remain at 600 feet and sideslopes would be 3 horizontal on 1 vertical. The dredging area is approximately 804 acres. Non-Federal interests would be responsible for dredging the berthing area adjacent to the Long Wharf. Disposal at the Alcatraz site is assumed.

The final step of this Section is to select a preferred plan from the detailed plans just described. To complete this step four tests, (Functional Effectiveness, Public Acceptability, Economic Efficiency and Completeness) are once again applied. This second screening process does two things. First, it shows the disposition of the action alternative in light of the No Action Alternative and second, it details the action alternative in terms of its outputs. Table 4 below presents the comparison of alternatives. The environmental impacts of these alternatives are discussed in Environmental Impact Statement (Section 7).

TABLE 4

COMPARISON OF ALTERNATIVES
JOHN F. BALDWIN SHIP CHANNEL PHASE II

ALTERNATIVES DESCRIPTOR	DREDGING SOUTHAMPTON SHOAL CHANNEL (SSC)	NO ACTION
CHANNEL IMPROVEMENTS	Deepen to -45' MLLW Width 600'	NONE Depth -35' MLLW Width 600'
RICHMOND LONG-WHARF MANEUVERING AREA	Widen existing connection with channel and deepen to -45' MLLW	Maintain Existing at -35' MLLW
DISPOSAL AREA	Alcatraz (7 mi)	Alcatraz (Maintenance)
DREDGING METHOD	Clamshell and Barge (Assumed)	Hopper Dredge (Maintenance)
NEW WORK DREDGING	7.9 M CY	NONE
CONSTRUCTION PERIOD	44 Mos	NONE
AVERAGE ANNUAL MAINTENANCE DREDGING	135,000 CY	82,000 CY
FUNCTIONAL EFFECTIVENESS		
ACCESS TO RICHMOND LONGWHARF (RLW)	Full access to vessels with drafts up to 40'	Full access to vessels with drafts up to 30'
DISTANCE TO RLW FROM B&W BUOY "A"	4.1 N Mi	N/A
OBSTRUCTIONS TO NAVIGATION	NONE	NONE
NAVIGATION LIMITATIONS	NONE	NONE
VESSELS LIMITATIONS	40' Draft Vessels	30' Draft Vessels

TABLE 4 (Cont'd)

COMPARISON OF ALTERNATIVES
JOHN F. BALDWIN SHIP CHANNEL PHASE II

ALTERNATIVES DESCRIPTOR	DREDGING SOUTHAMPTON SHOAL CHANNEL (SSC)	NO ACTION
	PUBLIC ACCEPTABILITY	
LOCAL SUPPORT	Strong Support Indicated in Richmond Harbor Report	N/A
USER PREFERENCE	Preferred by RLW Users and local Pilots Assns.	N/A
AGENCY CONCERNS	USFWS magnitude of disposal suggest ebb tide disposal	NONE
COMPATIBILITY WITH INSTITUTIONAL ARRANGEMENTS AND REQUIREMENTS	Fully compatible	Fully compatible
	ECONOMIC EFFICIENCY	
FIRST COSTS	FED $41,700,000 NON-FED 1,450,000 TOTAL $43,150,000	NONE
IDC**	$ 2,730,000	
ANNUAL COSTS	CAP $1,869,000 (3 1/4%) O&M 250,000 * TOTAL $2,119,000	O&M
ANNUAL BENEFITS	$5,632,000	N/A
NET ANNUAL BENEFITS	$3,513,000	N/A
B/C	2.7/1	N/A

* Incremental maintenance costs due to project improvements.
** Interest During Construction.

TABLE 4 (Cont'd)

COMPARISON OF ALTERNATIVES
JOHN F. BALDWIN SHIP CHANNEL PHASE II

ALTERNATIVES DESCRIPTOR	DREDGING SOUTHAMPTON SHOAL CHANNEL (SSC)	NO ACTION
	COMPLETENESS	
CHANNEL DEPTH	Adequate in meeting planning objectives	Inadequate in meeting planning objectives
CHANNEL WIDTH	Adequate in meeting planning objectives	Same as SSC
ROUTE TO RLW	Adequate in meeting planning objectives	N/A
NAVIGATION EFFICIENCY	Adequate in meeting planning objectives	Inadequate in meeting planning objective

Based on the preceding screenings of alternatives a decision for dredging the Southampton Shoal Channel is made. The No-Action Plan was not selected because it would maintain existing inefficient navigation conditions and therefore does not address the prescribed planning objectives. Dredging Southampton Shoal Channel is selected as the preferred alternative based on the following desirable outputs:

1. Maximum operational efficiency (reduction in lightering and tidal delays) in transporting crude petroleum between Central San Francisco Bay and the Richmond Long Wharf by providing a deep-draft, direct access, channel.

2. Increase in navigation safety for transporting crude petroleum between Central San Francisco Bay and the Richmond Long Wharf by eliminating the need for navigation in an area of man-made and natural obstructions to navigation.

3. Compatibility with public concerns.

SECTION 4

BASIS OF DESIGN

The existing Southampton Shoal Channel is 600 feet in width, with some flared widening at either end and is maintained at -35 feet MLLW.The existing Richmond Long Wharf Maneuvering Area located adjacent to the Wharf is irregular in configuration, varies from 600 to 2800 feet in width, extends for 8,400 feet, and is also maintained at a depth of -35 feet MLLW. The Southhampton Channel provides access from San Francisco Bay to the southwesterly side of the maneuvering area. The project improvement would result in deepening the existing 600 feet wide Southampton Channel to -45 feet MLLW, some widening at the North end for better entry into the maneuvering area and lengthening of the flared southerly end to accomodate the deeper channel. The project improvement would also result in deepening of the maneuvering area to -45 feet within its existing configuration. For plan and sections for the proposed channel improvement, see Drawing 9-1-102. (Sheets 1 through 4 see Appendix D)

4.01 Geotechnical Considerations

a) Geology. The Richmond Long Wharf Maneuvering Area is located in a natural depression or drainage area in the broad, low-lying bay plain bordering the northeastern shore of San Francisco Bay. Elevations on the bay plain in the vicinity of the harbor area vary from sea level to about 20 feet above sea level then gradually rising to the base of the Berkeley Hills to the east. Two hills, about 200 and 300 feet in height, are located in the area to the west and north of the Santa Fe Harbor Channel. The project site is a deep cradle of bedrock filled with clayey and silty marsh deposits commonly called "Bay Mud". The Franciscan formation is the bedrock of the area and is the oldest geologic unit present. Franciscan rocks are well exposed in the ridge west of the project site and 2000' northeast of the inner harbor basin. The proposed project area consists of younger bay mud which is a soft, gray, silty clay with minor amounts of fine sand and shell bits. Because this mud tends to become firmer and contains less water with increasing depth, engineers have divided it into two portions: a soft unconsolidated upper layer, and the older firmer layer beneath. The thickness of the younger bay mud in the proposed project area ranges from 20 to 60 feet. Because of the chemical composition, this mud tends to be very soft and plastic when wet and becomes brittle and shrinks when dried. Generally a fine sand strata, 10 to 50 feet thick, lies underneath portions of younger bay mud.

A concealed trace of the San Pablo Fault crosses beneath the project from the northwest to the southeast. The San Pablo Fault is considered inactive since there is no existing evidence nor historical report of surface rupturing in the overlying alluvium near the project area. The Hayward Fault, about three miles east of the project area, is considered active along its trace south of Richmond where exposures and surface expressions both indicate movement during historic time. The Hayward Fault is not considered close enough to the project to constitute a hazard from ground rupture; however, seismic activity on the Hayward Fault could produce strong ground shaking at the project area.

b) Soils. Early in 1982 soil borings were obtained for the Richmond Long Wharf Maneuvering Area. Locations of these holes are shown in Drawing No. 9-1-102 (sheet 1 of 4) and logs are shown on Drawing No. 9-5-6 (See Appendix D). Visual classification of samples were made in the field and material gradations were determined by lab tests. From the visual inspection of the material in both project areas, soils would vary from clay sands to sandy clays. Southampton Shoal Channel traverses through a sandy bar type formation associated with San Pablo Straits.[6/]

Parameters used in the slope stability analysis were based on similiar soils in other Bay areas. Stability analyses demonstrated that the 3 on 1 slope is stable for all static conditions. This same slope was determined to be readily acceptable for the somewhat more sandy Southampton Shoal Channel. The existing channel has been self maintaining with side slopes of 2 on 1.

4.02 Design Considerations

The authorized project depth of 45 feet MLLW was selected to provide a 5-foot safe clearance for petroleum tanker traffic. The safe channel clearance consists of one foot for squat or drawdown of water surrounding the vessel, two feet of trim of the vessel for better handling characteristics, and two feet of clearance between the ship's keel and channel bottom, totaling five feet. Tankers drawing a maximum draft of 45 feet (85,000 DWT tanker fully loaded or other larger tanker light loaded) would have ingress or egress at this depth, given a five-foot tidal advantage. (The full tidal range between mean lower low water and mean higher high water is 5.8 feet at nearby Richmond Inner Harbor.)

The forty five foot depth MLLW for improvement of the Richmond Long Wharf Maneuvering Area and the Southampton Shoal Channel is compatible with the improved depth of the San Francisco Bar Entrance Channel. Previous deepening (1974) and continued maintenance of the San Francisco Bar Entrance Channel to 55 feet MLLW under this same authorization, limits the size of tankers having access to San Franicsco Bay to those with a maximum draft of 50 feet (55-foot channel depth, plus five-foot tidal advantage, less ten-foot safe bottom clearance); or to larger tankers which are light loaded to an equivalent draft. With the channel improvement, ship lightering demands are minimized, with only those tankers loaded to drafts in excess of 45 feet requiring lightering under conditions of tidal advantage. Southampton Shoal Channel, at 600 feet width, presently provides safe one-way passage for tankers as large as 150,000 DWT with beam widths of about 150 feet. A two-way channel was excluded from consideration after discussion with the U.S. Coast Guard and San Francisco Bay Pilots. Agreement was reached that only one-way traffic movements would be made along the route for safe passage, due to the increasing size of vessels, handling characteristics, weather conditions, current velocities and directions and visibility limitations. The maximum waiting time for a vessel due to a one-way channel would be about 120 minutes. With vessel calls projected at 3 per day to the year 2000, the probability of significant delays is small and ship traffic congestion would be minimal.

6/ Dredge Disposal Study - San Francisco Bay And Estuary, Appendix B, Corps of Engineers, San Francisco District, February 1979.

The proposed channel is being tested by a navigation simulator developed by the U.S. Amry Corps of Engineers Waterways Experiment Station (WES) in Vicksburg, Mississippi. The simulation study provides an opportunity to test the new channel configuration in a safe, controlled environment prior to construction. The major objective of the simulation study is to establish empirical support for the design of the recommended improvement plan.

4.03 Basis for Federal Cost

a) Dredging. Dredging of these project features assumed the use of a clamshell dredge equipped with a 16 cy bucket with teeth and weighing over 20 tons to provide force and penetration for removal of consolidated sands. The analysis also incorporated a supporting plant for the dredge and scows for transport of the dredged material to the disposal site. The new project estimate is based on a 4-year construction period to dredge the estimated 7,900,000 cy of material located between the currently maintained depth of 35 feet MLLW and the authorized depth of 45 feet. The estimate is composed of the required dredging and 75 percent of the allowable 2 foot overdepth dredging. From dredging experience within the San Francisco Bay Area it was determined that approximately 75 percent of the estimated overdepth is actually removed. Payment is made on the basis of overdepth material finally removed. Disposal was assumed to be made at the Alcatraz deepwater site 7 miles from the project. Plans and Specifications for this project, however, would provide for dredging and disposal by other methods (i.e. hopper, hydraulic) on a competitive bid basis providing the proposed method meets environmental requirements for Alcatraz dredge disposal.

b) Dredged Material Disposal. Material to be dredged is nearly equally divided between the Richmond Long Wharf Maneuvering Area and the Southampton Shoal Channel; 3,884,000 cy and 3,992,000 cy, respectively. Material will be transported to the existing Alcatraz deepwater disposal site in San Francisco Bay, a distance of seven miles from the project. Each scow will unload upon arrival at the disposal site, irrespective of tidal cycle.

c) Navigation Aids. Flared transition sections at either end of the Southampton Shoal channel will make necessary the installation of additional navigational aids at angle points and channel boundaries. These installations would be made by the U.S. Coast Guard at an estimated cost of $75,000.

d) Price Level. Costs are developed on the basis of other Bay Area dredging projects at November 1982 price levels. First costs are shown on Table 5.

4.04 Basis For Non-Federal Costs.

To accomodate traffic using the Federally improved project the non-Federal estimate assumes that the non-Federal interests will deepen the 125 foot wide by 3,700-foot long berthing strip to -50 feet MLLW which is consistent with the present practice of maintaining the berthing area 5 feet below the Federal channel depth. This dredging improvement would therefore require removal of 275,000 cy of material. The estimate consists of the required dredge quantity and 75 percent of the allowable 2 foot overdepth quantity. Reduction of overdepth dredge quantity is based on Bay Area dredging experience which shows that on an average 75 percent of estimated overdepth quantity is actually removed. For purposes of this estimate it is assumed that the non-Federal dredging would be incorporated in the contract for the Federal dredging improvement, subject to reimbursement by local interests. Thus mobilization and demobilization is relatively minor cost item simply involving assignment of a pro-rata share of the Federal mobilization and demobilization to the local sponsor. Material would be excavated, transported 7 miles to the disposal site near Alcatraz where it would be disposed of in deep water. Costs are developed on the basis of other Bay Area dredging projects at November 1982 price levels. First costs for non-Federal work are shown on Table 6.

TABLE 5

ESTIMATE OF FEATURE FEDERAL FIRST COST
NOVEMBER 1982 PRICE LEVEL

Item	Description	1/ Quantity	Unit	2/ Unit Price	Total
1.	Mobilization & Demobilization	1	Job	L.S.	$ 380,000
2.	Dredging				
	Richmond Long Wharf Maneuvering Area Dredge -35 feet to -45 feet MLLW	3,884,000	cy	3.95	15,342,000
	Southampton Shoal Channel Dredge -35 feet to -45 feet MLLW	3,992,000	cy	3.95	15,768,000
	Subtotal				31,490,000
	Contingencies @ 20%				6,310,000
	Subtotal				$37,800,000
	Supervision & Administration (4%)				1,525,000
	Engineering & Design (6%)				2,300,000
	Subtotal				$41,625,000
	Navigation Aids (USCG)				75,000
	TOTAL FEDERAL FIRST COST				$41,700,000

Note: Interest during construction has been derived based on a total construction cost of $41,700,000 over a four year period. Mob and Demob costs are assigned equally to the first and last year and dredging costs are assigned on a uniform annual basis. Using the authorized interest rate of 3 1/4%, the present worth of the Federal cost of interest during construction totals $2,730,000.

1/ Quantities include 75% of 2 feet allowable overdepth.
2/ Unit prices do not include inflation during construction.

TABLE 6

ESTIMATE OF FEATURE NON-FEDERAL COST
NOVEMBER 1982 PRICE LEVEL

Item	Description	Quantity 1/	Unit	Unit Price	Total
	Dredging Berthing Area at Richmond Long Wharf				
1.	Mobilization & Demobilization	1	Job	L.S.	$ 10,000
2.	Dredge -50' MLLW	275,000	cy	3.95	1,086,000
	Subtotal				1,096,000
	Contingencies 20%				219,000
	Subtotal				1,315,000
	Supervision & Administration (4%)				55,000
	Engineering & Design (6%)				80,000
	TOTAL FEATURE NON-FEDERAL COST				$1,450,000

1/ Quantity includes 75% of 2 feet allowable overdepth.

4.05 Maintenance

a) Federal

Maintenance related to deepening the Long Wharf Maneuvering Area from -35 to -45 feet will require the dredging of an additional 45,000 cy of material annually, for a total of 115,000 cy per year. Additional maintenance for Southampton Shoal Channel due to deepening will be 8,000 cy annually for a total of 20,000 cy per year. These estimates are derived by use of the formula below which assumes the increased maintenance dredging quantities to be directly proportional to the ratio of the squares of the new and existing depths. Since the project does not include channel widening, the factors for channel bottom areas are not included.

$$Z \frac{(d2)^2}{(d1)^2} - Z = \text{Increased dredging quantity}$$

where: Z = Average annual maintenance quantity (70,000 cy for Long Wharf and 12,000 cy for Southampton)

d2 = New water depth (-45')

d1 = Old water depth (-35')

Based on a 2 year dredging cycle for the Long Wharf and a 5 year cycle for Southampton, additional maintenance dredging costs due to channel deepening are $170,000 per year and $80,000 per year respectively. Disposal at Alcatraz was assumed; mobilization was prorated; November 1982 price levels were used.

b) Non-Federal

It is expected that the local interests will continue to maintain the Long Wharf berthing area to a depth compatible with the Federal project. Deepening the berthing area is not expected to impact appreciably on non-federal maintenance costs.

SECTION 5

ASSURANCE OF LOCAL COOPERATION

5.00 Before the project modifications proposed herein are constructed, non-Federal interests are required to provide assurance of local cooperation. The Board of Supervisors of Contra Costa County, by Resolution No. 2156 adopted 6 August 1965, endorsed the entire San Francisco Bay to Stockton Navigation Channels Project and expressed the intention of providing the required assurances of local cooperation. Prior to advertising for construction bids, the project sponsor will enter into an agreement with the Government in compliance with Section 221 of the Flood Control Act 1970, Public Law 91-611. This agreement will cover items of local cooperation required to implement the Phase II segment of the John F. Baldwin Project.

5.01 Departures From General Provisions

Certain items of local cooperation apply to other segments of the authorized project but are not applicable to the proposed Phase II feature. There is only one departure from the general provisions of the Project Document. The authorizing document set forth both aquatic and land disposal as alternatives for this segment of the project. Land disposal was found to be infeasible due to land use changes since the Survey Report. Since aquatic disposal is the selected method there is no requirement for land sites, retention dikes, relocation assistance, or other facilities related to land disposal.

5.02 Requirements of Phase II

Local interest will in addition to the general requirements of law for this type of project, agree to:

a. Give assurances that lands, easements, and right-of-way will be provided for construction and maintenance;

b. Agree to hold and save the United States free from damages which may result form construction and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractors;

c. Assure the accomplishment without cost to the United States of such alteration as required in sewer, water supply, drainage, transportation facilities and other utility facilities; as well as their maintenance;

d. Prohibit erection of any structure within 125 feet of project channels and basins;

e. Provide and maintain when and as required without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths in the related project areas;

5.03 Cost Sharing

During the course of the study, cost sharing became an issue because of the single beneficiary question at the Richmond Long Wharf. The authorizing legislation (79 Stat. 1089 and 1091) did not require local cost sharing for the navigation improvements in the Long Wharf Area. Congress adopted the recommendation of the Chief of Engineers, which did not include non-Federal cost sharing.

The position that local interests are not required by the authorizing legislation to share in the cost of improving the Long Wharf Maneuvering Area was reconfirmed by the Office of the Chief of Engineers on 10 June 1977.

SECTION 6

TENTATIVE CONCLUSIONS AND RECOMMENDATIONS

6.01 Conclusions. The District Commander concludes that providing deepwater access to the Richmond Long Wharf from Central San Francisco Bay is justified on the basis of tangible future monetary transportation savings in excess of feature costs. Further the District Commander concludes that an opportunity exists to eliminate known operational and safety disadvantages in providing this deepwater access through improving the Southampton Shoal Connecting Channel as opposed to improving the West Richmond Channel as authorized.

6.02 Recommendations. The District Commander recommends that this Interim Design Memorandum be approved as the basis for preparation of contract plans and specifications for improving the Southampton Shoal Connecting Channel and Richmond Long Wharf Maneuvering Area.

EDWARD M. LEE, JR.
COL, CE
Commanding

DRAFT ENVIRONMENTAL IMPACT STATEMENT

JOHN F. BALDWIN SHIP CHANNEL
PHASE II
CENTRAL SAN FRANCISCO BAY SEGMENT

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SECTION 7

DRAFT ENVIRONMENTAL IMPACT STATEMENT

John F. Baldwin Ship Channel
Phase II
Central San Francisco Bay Segment

The responsible lead agency is the U.S. Army Engineer District, San Francisco
The responsible cooperating agency is the U.S. Fish and Wildlife Service, Sacramento

Abstract:

The U.S. Army Corps of Engineers was authorized by Congress (PL 89-298) to construct navigation improvements for crude petroleum import to San Francisco Bay Area refineries. The Corps of Engineers has found that the increased use of larger tankers has resulted in savings through reduction in transportation cost, but at the same time has rendered most in-bay ship channels serving Bay Area refineries inadequate. The channels are generally too shallow to accomodate fully loaded large tankers without tidal delays or lightering. Various solutions to these problems in Central San Francisco Bay were analyzed. Included in the detailed analysis was deep-draft access provided by the improvements to the existing Southampton Shoal Channel and Richmond Long Wharf Maneuvering Area. Evaluation of this route, and a no-action alternative was performed. The key environmental factors considered in determining the merits of the alternatives in this study were their impacts on (1) water quality, (2) benthos, (3) energy, (4) transportation efficiency and (5) navigational safety.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY 20 MAR 1984

If you would like further information on this statement, please contact

Mr. Rod Chisholm
U.S. Army Engineer District,
San Francisco
211 Main Street
San Francisco, CA 94105
Commercial Telephone: (415) 974-0446
FTS Telephone: 454-0446

NOTE: Information, displays, maps, etc. discussed in the Interim Design Memorandum are incorporated by reference in the EIS.

DRAFT ENVIRONMENTAL IMPACT STATEMENT

SUMMARY

MAJOR CONCLUSIONS AND FINDINGS

The major conclusions and findings are stated in the following paragraphs:

A. NED Plan: The selected plan would deepen 1.1 miles of channel from 35 to 45 feet below MLLW datum, and would produce maximum net benefits over costs. Hence, this alternative satisfies the definition of an NED plan.

B. Selected Plan: The improvement of the Southampton Shoal Channel would consist of dredging 1.1 miles of existing channel and the existing Richmond Long Wharf Maneuvering Area from -35 feet (MLLW) to -45 feet (MLLW). An estimated 7,900,000 cubic yards of material would be dredged and disposed of in the approved Alcatraz Island Disposal Site. The estimated first cost of construction is $43,150,000. Annual costs are estimated at $2,119,000 including capital costs and operations and maintenance. The benefit-cost ratio of the project is calculated at 2.7/1.

C. Findings Regarding Section 404 of Clean Water Act:

1. No significant adaptions of the guidelines were made relative to this evaluation.

2. Of the three designated open water disposal sites in San Francisco Bay, the use of the Alcatraz Island site, SF-11, would result in the most amount of dredged material leaving the Bay system.

3. The planned disposal of dredged material at the Alcatraz site would not violate any applicable State water quality standards. Short term turbidity will occur during each discrete dump. Turbidity generated by the disposal activity will be temporary. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. Use of the selected disposal site will not harm any endangered species or their critical habitat or violate protective measures of any marine sanctuary or wildlife refuge.

5. The proposed disposal of dredged material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic escosystem diversity, productivity and stability and recreational, aesthetic, and economic values will not occur.

6. Steps to minimize potential adverse impacts of the discharge on aquatic systems included extensive sediment quality testing and evaluation of disposal on ebb tide. The added cost of ebb disposal, however is approximately $3.7 million for this project. The U.S. Fish and Wildlife Service has been requested to provide additional information on the environmental benefits of ebb tide disposal.

7. On the basis of the guidelines the proposed disposal site for the discharge of dredged material is specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

D. Findings Regarding Protection of Wetlands, Executive Order 11990:

1. Dredging sites and the selected disposal site are not located in or near wetlands.

2. No harm to any wetland area as a result of plan implementation is expected to occur.

3. The proposed action complies with this executive order and satisfies the Chief of Engineers Wetlands Policy.

E. Findings Regarding Cultural Resources: Based on investigations to evaluate the potential for prehistoric and historic cultural resources, the following findings were made: Deepening and widening of the channel would not impact recorded prehistoric or historic resources, and in all likelihood, would not result in discovery of presently unknown resources of these types.

F. Findings Regarding Floodplains Executive Order 11988:

1. The proposed action is not located in any base floodplain.

2. The proposed action does not have any impacts in any floodplain nor will it indirectly support floodplain development.

3. The proposed action is in compliance with this executive order.

G. Areas of Controversy: No areas of controversy have been identified at this time. Ebb tide disposal of dredge material as recommended by the U.S. Fish and Wildlife Service is being evaluated by the Corps. Ebb tide disposal increases the cost of the project by approximately $3.7 million over the assumed disposal procedure. The Fish and Wildlife Service has been requested to provide additional information regarding the specific environmental benefits involved in ebb tide disposal.

H. Unresolved Issues: No unresolved issues.

7-1 RELATIONSHIP TO APPLICABLE ENVIRONMENTAL LAWS, POLICIES AND PLANS

The following paragraphs list the principal environmental laws, policies or plans of Federal, State or local governments applicable to the proposed navigation improvements. Any inconsistencies between the proposed action and the laws, policies and plans are discussed, and the extent to which the proposed action shall reconcile such inconsistencies is also described. See Table 1-EIS for summary of alternative plans compliance with laws, policies and plans.

1.01 Clean Air Act. The objective of the Clean Air Act (P.L. 91-604; 84 Stat. 1704, 42 U.S.C. 1857 et seq) is to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population. The Act requires Federal agencies to perform an Air Quality Analysis for projects located within Air Quality Maintenance Areas to determine the effect of the proposed action upon the local Air Quality Maintenance Plan. It has been determined that emissions will not be increased by implementation of the proposed navigation improvements based on no change in the amount of cargo estimated for handling with existing facilities and a reduction in lightering activities. The Corps will require that the dredging contractor secure all necessary permits from the Bay Area Air Quality Maintenance District before construction.

1.02 National Environmental Policy Act (NEPA). NEPA (P.L. 91-190; 83 Stat. 852, 42 U.S.C. 4321-4327) established a national environmental policy to be considered in all Federal actions. NEPA directs all Federal agencies to include in every recommendation, report, proposal for legislation or other major Federal actions significantly affecting the quality of the human environment, a detailed environmantal impact statement. This environmental impact statement fulfills the requirements of NEPA.

1.03 Clean Water Act, Section 404. The objective of the Clean Water Act (P.L. 95-217; 33 U.S.C. 1344) is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Section 404(b) of the Clean Water Act as amended in 1977, requires that the Corps evaluate the impacts of the discharge of dredging or fill material into waters of the United States in order to make specified determinations and findings. A State Water Quality Certificate must be obtained for the discharge unless an exception is approved by Congress. An evaluation as specified in Section 404(b) has been included in this report, (see Appendix B, Section 404(b) Evaluation, for detailed information). A State Certificate will be requested for the proposed action in compliance with the above requirements.

1.04 Fish and Wildlife Coordination Act (FWCA). The FWCA (P.L. 85-624, 72 Stat. 563, 16 U.S.C. 661 et seq) requires that an action agency consult with the Fish and Wildlife Services (FWS), the National Marine Fisheries Service (NMFS) and state fish and wildlife agencies to determine the effects a project may have on fish and wildlife resources. Federal agencies must make the reports and recommendations of the FWS NMFS and State agency an integral part of the reports submitted to Congress for authorization of construction. The project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits. A U.S. Fish and Wildlife Service Report was included in the 1965 authorizing document. A supplement to this report is included with this document, see Appendix C.

1.05 Endangered Species Act, Section 7. Section 7(a) of the Act, P.L. 93-205 (87 Stat. 884, 16 U.S.C. 1531 et seq), requires that Federal agencies insure that their actions do not jeopardize the continued existence of endangered or threatened species or destroy or adversely modify the critical habitat that supports such species. Review of the U.S. Fish and Wildlife Service Listing and the State of California endangered species publications in relation to the tentatively-selected plan indicates no effect upon rare or endangered species or critical habitats. The U.S. Fish and Wildlife Service has confirmed this finding by its letter of 2 April 1982, (see Appendix C).

1.06 Executive Order 11990, May 24, 1977, Protection of Wetlands. This order states that Federal agencies should avoid to the extent possible the long-and short-term adverse impacts associated with destruction or modification of wetlands. No wetlands will be impacted by any project alternative.

1.07 Chief of Engineers Wetland Policy. This policy declares wetlands to be vital areas constituting productive and valuable public resources. Alteration or destruction of wetlands is discouraged as contrary to the public interest. As indicated above, no wetlands will be impacted by the project.

1.08 Water Resources Development Act, Section 150, P.L. 94-587 (WRDA). This legislation furnishes the Chief of Engineers with authority to plan and establish wetland areas in connection with dredging required for water resources development projects. The establishment of wetlands as provided in this Act was not determined feasible. The conditions of potential fill areas in the vicinity of the project do not permit the establishment of wetland areas without changing existing mudflats or shallow water areas.

1.09 National Historic Preservation Act (NHPA). The NHPA P.L. 80-665 (80 Stat. 915, 16 U.S.C. 470) requires that Federal agencies take into account the effect of their undertakings upon National Register properties. The National Register listing of Historic Places has been consulted and no National Register property shall be impacted by the project (see Appendix E CULTURAL RESOURCES, for further discussion).

1.10 Executive Order 11593, May 1971, Preservation and Enhancement of Cultural Resources. This executive order directs Federal agencies to assume leadership in preserving and enhancing the Nation's cultural heritage. The State Historic Preservation Officer has been contacted and it has been detemined that no State Historic Landmarks or State Points of Interest are located in the project area.

1.11 Section 4, Estuaries-Inventory-Study, Public law 90-454 (82 Stat. 625). This Act directs all Federal agencies to give consideration to estuaries and their natural resources and their importance for commercial and industrial developments, and to include in all project plans and reports affecting such estuaries and resources submitted to Congress a discussion by the Secretary of the Interior of such estuaries and such resources and the effects of the project upon them and his recommendations thereon. This discussion is provided under Fish and Wildlife Coordination Report (see Appendix C).

1.12 Coastal Zone Management Act Section 307, P.L. 92-583. This act directs all Federal agencies engaged in programs affecting the coastal zones to cooperate and participate with state and local governments and regional agencies in implementing the purposes of this act. The approved coastal management program for the area affected by the proposed project is contained in San Francisco Bay Plan, and the McAteer-Petris Act. In accordance with 15 CFR Part 930, it has been determined that the proposed action is consistent to the maximum extent possible with the approved coastal management program (See San Francisco Bay Plan).

1.13 San Francisco Bay Plan (Bay Conservation and Development Commission). The Bay Plan provides a comprehensive and enforceable basis for protecting the Bay as a natural resource benefiting both present and future generations, and developing the Bay and its shoreline to the highest potential with a minimum of Bay filling. The following Dredging Policies are stated:

a. Sedimentation resulting from dredging will be minimized by conducting disposal at a designated location where the maximum amount will be carried outside the Bay on ebb tide.

b. The dredging will not result in unnecessary filling solely to dispose of dredged sediment.

c. The disposal area should be selected or dredged with due consideration to being least harmful to the ecology of the Bay.

d. Any proposed channel improvements should be designed to prevent undermining of adjacent dikes and fills.

e. The proposed improvements will not damage underground aquifers.

This authorized channel deepening and disposal activity for the John F. Baldwin Ship Channel is considered compatible with the policies of dredging in the San Francisco Bay Plan since the disposal is planned for the EPA approved Alcatraz Disposal Site (SF - 11) and dredging will primarily be in existing navigation channels.

1.14 State Water Quality Control Policy for Enclosed Bays and Estuaries. Requirements of this policy applicable to dredging and disposal operations include: compliance of dredged material with Federal criteria for determining acceptability for disposal into bay waters and certification of compliance by the Regional Water Quality Control Board. Refer to paragraph C, Clean Water Act, Section 404.

1.15 State of California Wetland Policy. This policy recognizes the value of marshlands and other wetlands. No wetland areas will be impacted by any project alternative.

1.16 Richmond General Plan (Richmond Coastline Plan - South Richmond Shoreline.) This local plan provides guidance for the conservation and development of Richmond's shoreline and related land water areas and resolves conflicting desires for environmental protection and urban growth. The proposed navigation improvements are considered compatible with the policies of the General Plan, since no shoreline areas will be directly affected by the proposed improvements.

TABLE 1 -EIS

SUMMARY

RELATIONSHIP OF NAVIGATIONAL IMPROVEMENTS TO APPLICABLE ENVIRONMENTAL LAWS POLICIES AND PLANS

<u>Federal Policies</u>

Clean Air Act	Full Compliance
NEPA	Full Compliance-Draft Stage
Clean Water Act	Full Compliance
FWCA	Full Compliance-(supplemental report provided)
Endangered Species Act Requested	Full Compliance
EO 11990	Not Applicable
OCE Wetlands	Not Applicable
WRDA	Not Applicable
NHPA	Full Compliance
EO 11593	Full Compliance
Estuary Protection Act	Full Compliance
CZMA	Full Compliance

<u>State and Local Policies</u>

State Wetlands Policy	Not Applicable
BCDC S.F. Bay Plan	Full Compliance
SWRCB Bays and Estuaries	Full Compliance

<u>Local Land Use</u>

Richmond General Plan	Full Compliance

7-2 NEED FOR AND OBJECTIVES OF ACTION

2.01 Study Authority. This report is prepared pursuant to the Congressional authorization for construction of the San Francisco Bay to Stockton Ship Channel California Project; authorized in Public Law 89-298, adopted 27 October 1965 by the 89th Congress, 1st session. Basic information supporting authorization of the project is set forth in House Document No. 208 of that session. The portion of the project under study by the San Francisco District, the John F. Baldwin Ship Channel, has five areas of improvement and is defined as follows in the authorizing document.

a. Deepen the channel across San Francisco Bar to 55 feet without widening. (Completed in 1974)

b. Deepen the existing channel in Central San Francisco Bay leading through the west navigation opening of the Richmond-San Rafael Bridge to 45-foot depth and 600-foot width and deepen the maneuvering area adjacent to the Richmond Long Wharf to-45 feet; (the work considered in this EIS).

c. Deepen the Pinole Shoal Channel in San Pablo Bay within its existing 600-foot width and the maneuvering area at Oleum to 45 feet;

d. Construct a new 45 foot deep channel in Carquinez Strait near Martinez.

e. Deepen the Suisun Bay Channel to 45 feet as far upstream as Point Edith and widening and deepening to comparable depths of maneuvering areas at refinery terminals.

2.02 Purpose. The purpose of this EIS is to evaluate the environmental impacts of the alternatives for channel improvement in the Central San Francisco Bay, west of Richmond, California. The scope of this EIS is limited to a review of plans to accommodate present and prospective crude petroleum shipping through the Richmond Long Wharf facilities.

2.03 Public Concerns. Refinery facilities located at Richmond rely on waterborne transportation to supply most of their crude petroleum stocks. The present channel dimension of -35 feet MLLW deep restricts the size of tankers that can safely use the channel to 30 foot draft vessels. Larger tankers can enter San Francisco Bay through the Golden Gate but must be lightered or wait for high tide to proceed up the channel to the refineries. The proposed channel improvements are intended to rectify this situation for ships traveling to Richmond Long Wharf and provide a long term solution to the navigation problems associated with the delivery of crude petroleum to this immediate area. Specifically, the needs are to significantly reduce transportation costs by reducing tidal delays and lightering and increase safety. This concern for the navigational safety, as well as efficiency, of deep-draft vessel traffic using the Central Bay ship channels are addressed in the following planning objectives.

2.04 Planning Objectives. As a result of the analysis of public concerns the following objectives were derived and employed in plan formulation:

1. Improve efficiency (time savings) of navigation use at Central Bay and Richmond Long Wharf for the period of 1985 to 2035.

2. Improve the safety margin for navigation of vessel traffic using the Central Bay channels and Richmond Long Wharf for the period 1985 to 2035.

7-3 ALTERNATIVES

This section discusses the feasibility of various development concepts and construction methods. Included are non-dredging projects; channel improvements; single-stage channel development; development as a whole; land disposal and ocean disposal; in-bay disposal; and hydraulic dredging, hopper dredging, and clamshell dredging.

3.01 Central Bay Terminals and Ocean Monobuoys.

(a) Analysis of the John F. Baldwin Ship Channel improvement, authorized by Congress in 1965, included the examination of alternative non-dredging projects.1/ Central Bay terminal and ocean monobuoys were considered as alternatives to a channel improvement project. Various locations were explored as possible project locations for building a central bay terminal or an ocean monobuoy. One site considered for the construction of a central terminal was Treasure Island in San Francisco Bay. An area off-shore of Pacifica was studied as possible site for an ocean monobuoy. The Central Bay Terminal alternative included docking piers, an underwater pipeline, pumps and overland pipelines for distribution to refineries. The ocean alternative incorporated the use of monobuoys, underwater discharge pipelines, on-shore tank farm storage facilities, pumps, and overland and submarine pipelines for distribution of crude petroleum to each benefiting oil refinery.

(b) Implementation of these alternatives would not cause large impacts associated with dredging and disposal which are major concerns of deep-draft navigation improvement alternatives. Potential impacts of the central terminal or monobuoy alternatives include some aquatic impacts and a large number of land based impacts. The magnitude of environmental impacts for these alternatives have not been fully identified. However, construction of tank farms and many miles of pipelines in and through scenic areas, underwater terrain, and through congested urban and industrial areas would have significant impacts.

(c) The central terminal and monobuoy alternatives were considered economically feasible. But under current guidelines, these alternatives did not qualify for Federal cost sharing. Due to the high project cost and lack of local support, the central terminal and monobuoy alternatives were eliminated from further study.

1/ West Coast Deepwater Port Study, North Pacific Division/South Pacific Division, Corps of Engineers, 1976.

3.02 Single-Stage Development. This alternative contemplates development of the John F. Baldwin Ship Channel (Authorized Plan).

(a) The channel is a deep-draft navigation that would facilitate the delivery of crude petroleum to six existing San Francisco Bay Area refineries. It includes the deepening of existing channels between San Francisco Bay and Point Edith in Suisun Bay from -30 and -35 to -45 feet MLLW and the widening of channels and maneuvering areas, where required, to meet present and prospective navigation needs.

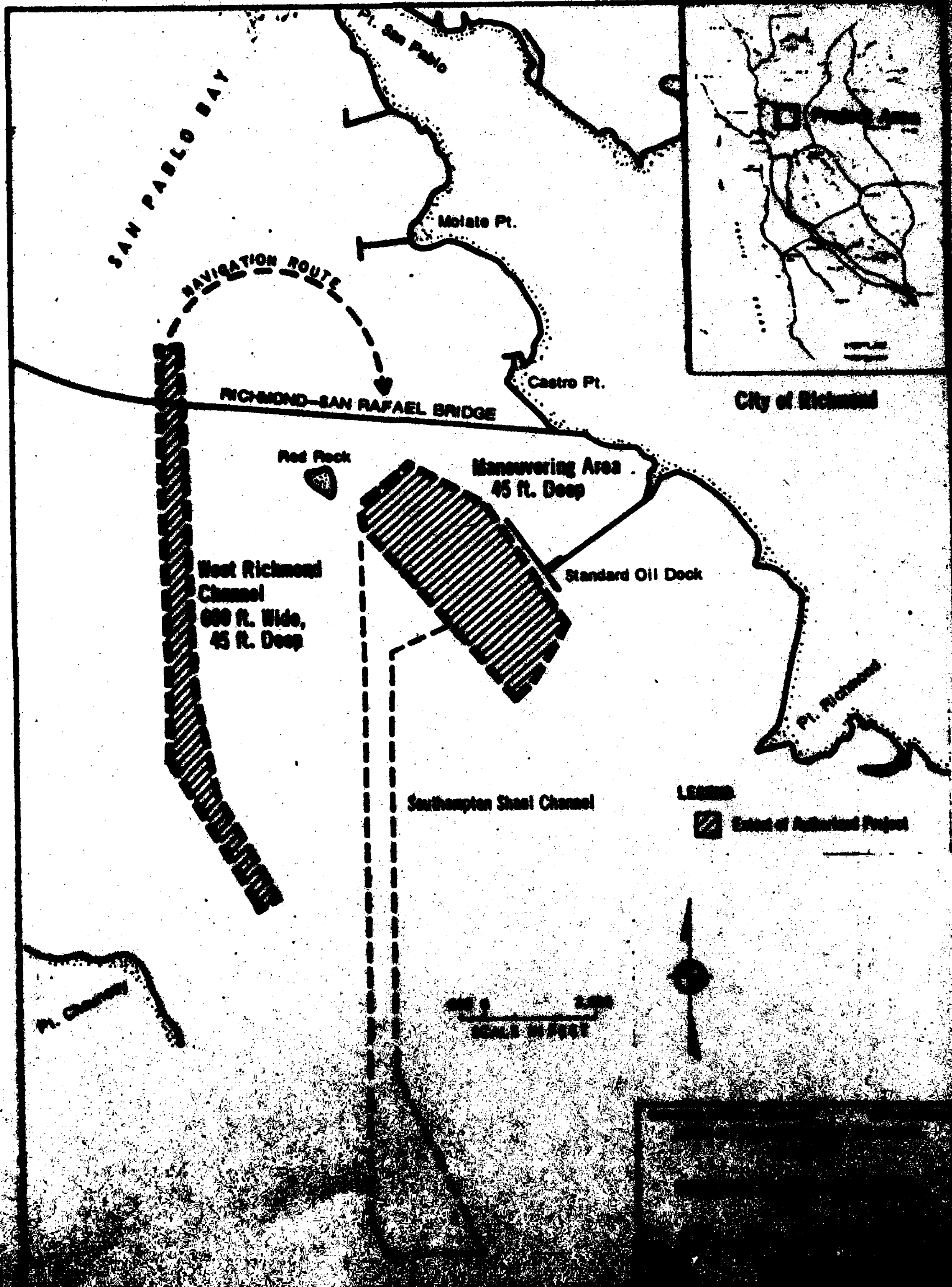
(b) Hydraulic model studies of the John F. Baldwin Ship Channel through Pinole Shoal without mitigation measures have shown increased salinity intrusion throughout Suisun Bay and the lower Delta, as a result of deepening. The consumptive uses of water (agricultural, municipal and industrial) would be affected by the increased salinity. In-stream uses would also be affected. The Delta serves as an important waterfowl producing area as well as a fish nursery and a major anadromous fish migrating passageway. The central and western Suisun Marsh also would be affected by salinity intrusion.

(c) To provide mitigative measures to offset the adverse impact of saline water in the Delta, a submerged salinity barrier was developed and model tested on the San Francisco Bay and Delta Hydraulic Model. The model tests of the fixed submerged barrier demonstrated the potential of such fixed structures to be means of maintaining control on most salinity intrusion. However further testing to refine the barrier design is needed. In addition the environmental effects of a submerged barrier, such as the effects on the null zone, movement of aquatic species, water surface elevations and sediment transport have yet to be adequately evaluated.

(d) The John F. Baldwin Project, developed as a whole, shows strong economic justification and would realize substantial transportation savings for the import of crude petroleum. However, based on the environmental uncertainties associated with the problem of mitigating salinity intrusion, construction of the project is being conducted in phases.

3.03 Construction of the West Richmond Channel and Richmond Long Wharf Maneuvering Area.

This plan (Figure EIS-1) consists of dredging the West Richmond Channel and the Maneuvering Area at the Richmond Long Wharf. The Channel would be deepened to -45 feet MLLW and 600 feet wide. The Maneuvering Area at Richmond Long Wharf would also be deepened to the 45' project depth over an area ranging from 600 to 2,000 feet in width and [illegible] feet in length. Completion of the dredging of this increment is the minimum required to [illegible] transportation savings in the import of crude oil. Under this alternative, however, large vessels [illegible] would [illegible] because of [illegible] and smaller vessels [illegible] would [illegible] the route during [illegible]



Pt. San Pablo
SAN PABLO BAY
Molate Pt.
NAVIGATION ROUTE
Castro Pt.
RICHMOND—SAN RAFAEL BRIDGE
City of Richmond
Red Rock
Maneuvering Area
45 ft. Deep
Standard Oil Dock
West Richmond
Channel
600 ft. Wide,
45 ft. Deep
Pt. Richmond
Southampton Shoal Channel
LEGEND
Pt. Chauncey

3.04 Dredge Disposal Alternatives.

(a) The disposal alternatives considered included land disposal, in-bay water disposal at the historically-used Alcatraz disposal site, and ocean disposal at a designated ocean disposal site.

(b) Land disposal of dredged material was included in the 1965 authorized project. The potential land disposal sites were re-evaluated on the basis of a four-mile pumping distance from the center of the project area. The land within an arc between Brooks Island and San Pablo Creek consists of wetlands and developed areas. Since it is economically preferable to locate the site near the dredge material source, the better sites fall into a category designated as wetlands or former wetlands (previously diked for various uses). Further complications in regard to land acquisition and site preparation costs as well as extensive mitigation requirements to offset the loss of wetlands and wildlife habitat makes this alternative impractical.

(c) The interim designated 100-fathom ocean disposal site was considered for the ocean disposal site. The site is located south of the Farallon Island at Latitude 37° 31'45" N and Longitude 122° 59' 00" W, 29.6 nautical miles from the Golden Gate. If the 100-fathom ocean disposal site were to be used, it must meet the requirements of the ecological evaluation required by section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, and Ocean Dumping Criteria. Due to the high transportation costs and the acceptability of in-bay disposal, ocean disposal was not considered further as an alternative.

3.05 Alternative Dredging Methods.

(a) Hopper and hydraulic are two alternative dredging methods considered along with the assumed clamshell and barge method. The type of equipment selected affects the characteristics of dredged material delivered to a disposal site and the duration, cost, and feasibility of a dredging project. Conversely, dredging and disposal site characteristics affect equipment selection.

(b) The hydraulic dredge removes bottom sediment by suction and pumps it through a pipeline for ultimate disposal. Hydraulic dredges can pump material up to three miles without the use of booster pumps. The use of hydraulic dredging with pipeline disposal for the proposed project would involve a pump distance of up to 7 miles, and traverse an area that is not only the navigation hub of San Francisco Bay but also an area of difficult currents and surface winds. At least one booster pump would be required to move the material to any disposal site. Because of these obvious technical and economic limitations this dredging method was not considered further in the study.

(c) Hydraulic dredging also can be accomplished using barges to transport the dredged material to the disposal site. The use of barges eliminates the technical and economic limitations of a long pipeline, but it is still not very cost effective because slurried dredge [illegible]. Project dredging by this method is technically feasible and it may be considered as an alternative to the assumed dredging method if [illegible] bid is competitive with the assumed dredging method.

(d) The hopper dredge is a self-propelled ocean-going vessel which dredges material from the bottom by hydraulic suction via pipes trailed to the sides of the vessel. The dredged material is pumped into bins or hoppers in the vessel, from which it can be discharged either by bottom dumping or by direct pumpout. Although the hopper dredge is efficient, it is an expensive transport mode because of its high operating cost, due primarily to its large crew. On the other hand, it utilizes less fuel than the clamshell dredge plant which requires a complement of barges and tugboats. Project dredging by hopper dredge is technically feasible and may be considered for the proposed work if contractors with hopper dredge capability to meet project construction schedule are available.

7-4 DESCRIPTION OF ALTERNATIVE PLANS

4.01 No Action.

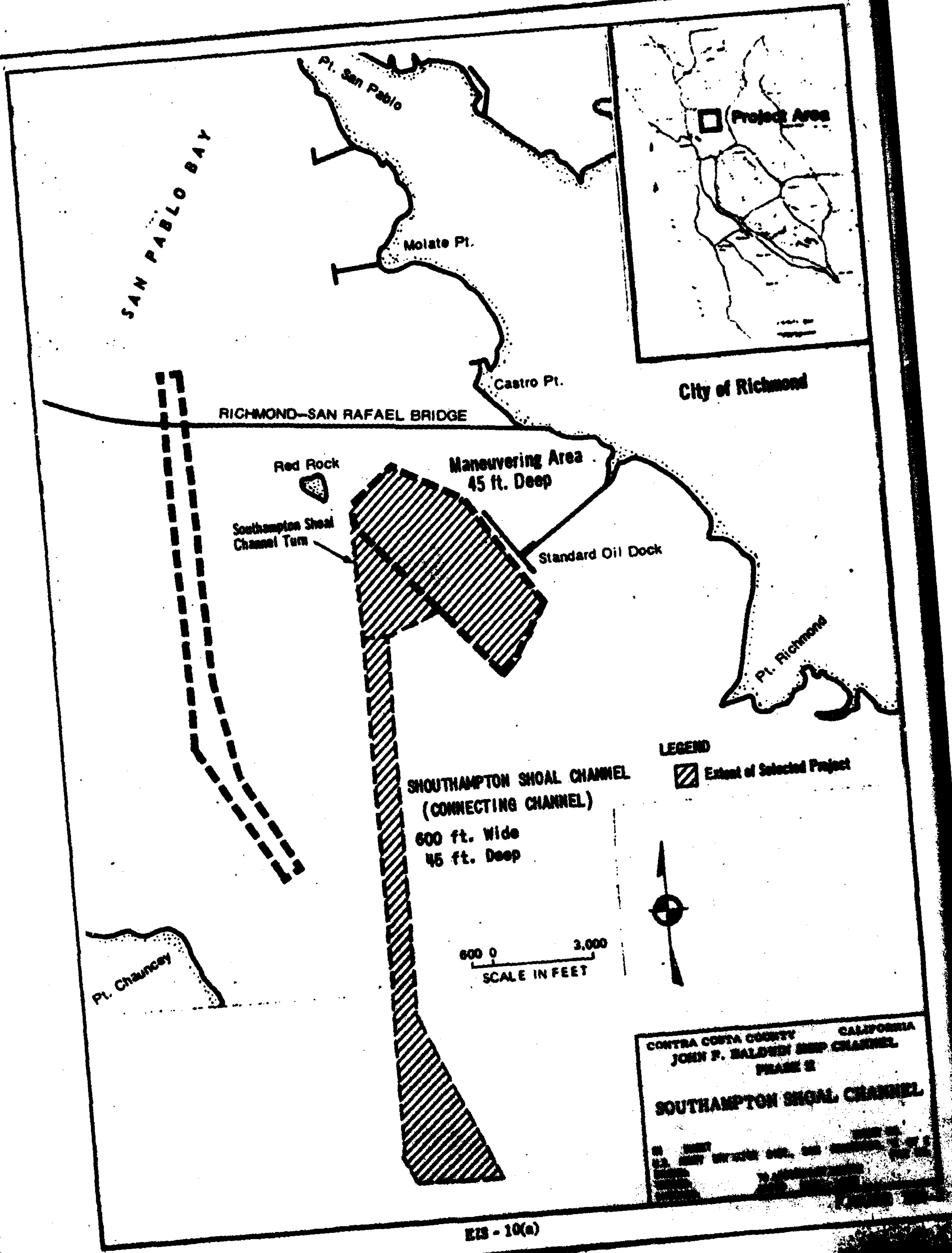
(a) With this alternative deep-draft navigation through Central San Francisco Bay to Richmond Long Wharf would be restricted. The only fully loaded tankers, that could safely call at the Richmond Long Wharf without tidal delays would be those with drafts of 30 feet or less. Vessels with design drafts greater than 30 feet could still call at Richmond Long Wharf, but only under less than fully loaded conditions or after waiting for high tides. In addition, navigation difficulties at Richmond Long Wharf would continue due to the turning basin depth restrictions, even though the Standard Oil Company has partially deepened its Long Wharf facility to better accommodate tankers used by that firm.

(b) To overcome the draft constraint of existing channels, deliveries would be met by increased lightering of large tankers in Central San Francisco Bay, south of the Bay Bridge, and increased use of existing channels by large tankers at high tide.

(c) The current magnitude of channel maintenance dredging would continue at approximately 82,000 cy per year. This activity results in short-term disturbances to the channel bottom. Disposal of dredged material from maintenance dredging in the Central Bay, including sediments from Richmond Long Wharf, is also expected to continue. Presently, annual average disposal at the Alcatraz site totals about 5 million cubic yards, approximately 70,000 cubic yards is from Richmond Long Wharf (35' depth). Some increases in the total volume of maintenance dredged material may be anticipated due to the other deepening projects.

4.02 Plan 1: [illegible]

(a) This plan [illegible] would provide direct [illegible] [illegible]



Pt. San Pablo
SAN PABLO BAY
Molate Pt.
Project Area
Castro Pt.
City of Richmond
RICHMOND-SAN RAFAEL BRIDGE
Red Rock
Maneuvering Area
45 ft. Deep
Southampton Shoal
Channel Turn
Standard Oil Dock
Pt. Richmond
LEGEND
Extent of Selected Project
SHOUTHAMPTON SHOAL CHANNEL
(CONNECTING CHANNEL)
600 ft. Wide
45 ft. Deep
600 0 3,000
SCALE IN FEET
Pt. Chauncey
CONTRA COSTA COUNTY CALIFORNIA
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
SOUTHAMPTON SHOAL CHANNEL

(b) Maintenance dredging in the Long Wharf Maneuvering Area would increase by an estimated 45,000 cubic yards per year. At -35' MLLW, the Southampton Shoal Channel has required infrequent, minimal maintenance dredging. It is estimated that maintenance of the -45' channel would increase by 8,000 cubic yards annually.

(c) The Federal Government would be responsible for supervision and administration of construction, maintenance of the channel to the selected dimensions, and provision and maintenance of necessary aids to navigation.

7-5 EXISTING ENVIRONMENTAL CONDITIONS

5.01 Location. The Southampton Shoal Connecting Channel is an in-bay shipping channel located west of Richmond Harbor. The Harbor is situated on the eastern side of San Francisco Bay, approximately 14 miles northeast of the Golden Gate Bridge. The West Richmond Channel (-35 feet MLLW) extends for about 3 miles from central San Francisco Bay through the west navigation opening of the Richmond - San Rafael Bridge and into the deep water of San Pablo Strait just upstream of the bridge. Parallel to the southern half of the West Richmond Channel is the Southampton Shoal Channel which provides a direct access to Richmond Harbor and the Long Wharf Maneuvering Area. The existing project maneuvering area near Richmond Long Wharf extends northward toward deep water near the east navigation opening of the bridge.

5.02 Economy. Richmond Harbor region is a Bay Area commercial port with petroleum and petroleum related products accounting for 75 percent of its total waterborne commerce. Tankers and containerships, as well as other craft, navigate through the in-bay shipping channels to reach Richmond. The nine-county Bay Area, is the second largest population center and marketing area on the Pacific Cost, and the seventh largest in the United States. The San Francisco Customs District ranks the third largest on the West Coast in international trade. The Port of Oakland handles the most tonnage of the fifteen areas of entry in the district, with Richmond handling the second most. Both of these ports are served by transcontinental railways and both are critical transfer points for waterborne commerce to land-based transportation modes. Most of the crude petroleum transported to Richmond is handled at Richmond Long Wharf which is operated by the Standard Oil Company. Exports from Richmond Harbor include machinery and transport equipment, food, and live animals. Water sports such as fishing and boating, are of minor importance in the port areas.

5.03 Ecology.

(a) The mudflats and marshes to the north and south of Richmond Harbor, and the beaches of Brooks Island to the west are among the most significant areas from an ecological standpoint in the study area. These productive areas support a myriad of plankton, clam, shrimp, barnacles, insects, copepods, worms, and small fish which are the essential food supply of the larger fish and waterfowl in the Bay.

(b) The aquatic habitat includes the open water and bottom area below the low tide line. Living in the water are fish, invertebrates, and plankton. The mud and sand bottom support a variety of shellfish and worms. Together this biological community forms a food web that supports a variety of native and migratory fish and waterfowl as well as adult concentrations of harbor seals.

(c) Crabs are found in the deeper waters off the shores of Point San Pablo and the coast of the San Pablo promontory. In the areas north of Point Isabel and around Point Richmond, beds of clams exist. All of the central and northern San Francisco Bay is an important recreation fishing area and has a high potential re-establishing a commercial shellfish fishery. This potential however, depends on the maintenance of spawning and nursery areas, and continuing improvement of the quality of the Bay water.

5.04 Earthquake Hazard. The Richmond Port area is subject to earthquakes to the same degree as most other areas in California. The amount of damage that might occur is related in part to the geology of the site.

5.05 Air Quality. The future air quality in the Richmond area was analyzed by the Richmond Public Works Department for the Environmental Impact Report, Richmond Redevelopment Plan. The Environmental Impact Report states:

> "Consultations were held with the personnel of the Bay Area Air Pollution Control District (BAAPCD). It was on their recommendation that, for the purpose of this analysis, the primary generator of pollutants is assumed to be the vehicular element and that any other generators would be considered of incidental importance."

In 1981 the San Francisco District performed an air quality analysis for the Richmond Harbor (including the Richmond Long Wharf) when considering deep-draft navigation improvements for that area. 2/ This analysis showed that air quality in Richmond generally is "good", and that while dredging would have a short-term impact on air quality conditions, no significant changes in future air quality conditions were identified with or without the project.

2/ Richmond Harbor Feasibility Report, Appendix K, Corps of Engineers, San Francisco District, 1981.

7-6 SIGNIFICANT RESOURCES

6.01 <u>Study Area</u>. The "study area" (Figure EIS-3) is defined as the Central San Francisco Bay from the Golden Gate Bridge in the West to the San Francisco-Oakland Bay Bridge in the South and the Richmond - San Rafael Bridge in the North. The project area is comprised of West Richmond Channel, the Southampton Shoal Channel and Richmond Long Wharf Maneuvering Area. It also includes the waters of existing disposal site near Alcatraz Island. These are the areas directly impacted by implementation of any action alternative. Unless otherwise stated the impacts discussed apply to only the project area.

6.02 <u>Environmental Relationship Matrix</u>.

(a) The environmental relationship matrix that follows was developed by identifying the interaction between elements that exist within the study area. These relationships provide information for assessing the ecosystem's response to natural and man-made changes either directly or indirectly associated with the recommended plan and the alternatives. Definitions of the elements on the matrix are presented in Table EIS-2. The environmental relationship matrix itself is on Figure EIS-4.

(b) When anaylzing the environmental matrix that follows, it should be remembered that the elements listed in columns act upon those listed in rows and that the relationships indicated are the primary relationships that exist within the study area.

6.03 <u>Analysis of Significant Resources</u>.

(a) <u>Water Quality</u>.

(1) This resource is presented as significant based on the concerns of the Clean Water Act of 1977. Water quality parameters are directly related to the interaction of sediment disturbances and water column effects at the dredging and disposal sites under consideration. Water quality parameters of concern include: concentrations of dissolved oxygen, heavy metals, petroleum hydrocarbons and pesticides. Since most of the effects of dredging and disposal activities upon water quality concerns are presently identified as short-term in nature, existing values for dissolved oxygen concentration and suspended solids are not expected to change.

(2) In order to compare the extent of the short-term impact of the alternative plans, attention shall be directed to the duration of the dredging and disposal operations and the expected volume of material to be disposed including the expected maintenance dredging quantities. All of the final alternative plans would result in sediment disturbance from dredging and disposal operations. However, chemical impacts upon water quality resulting from such sediment disturbance have been shown to be short-term and insignificant due to dilution and dispersion in the Bay (see Appendix B, SECTION 404(b) EVALUATION, for discussion).

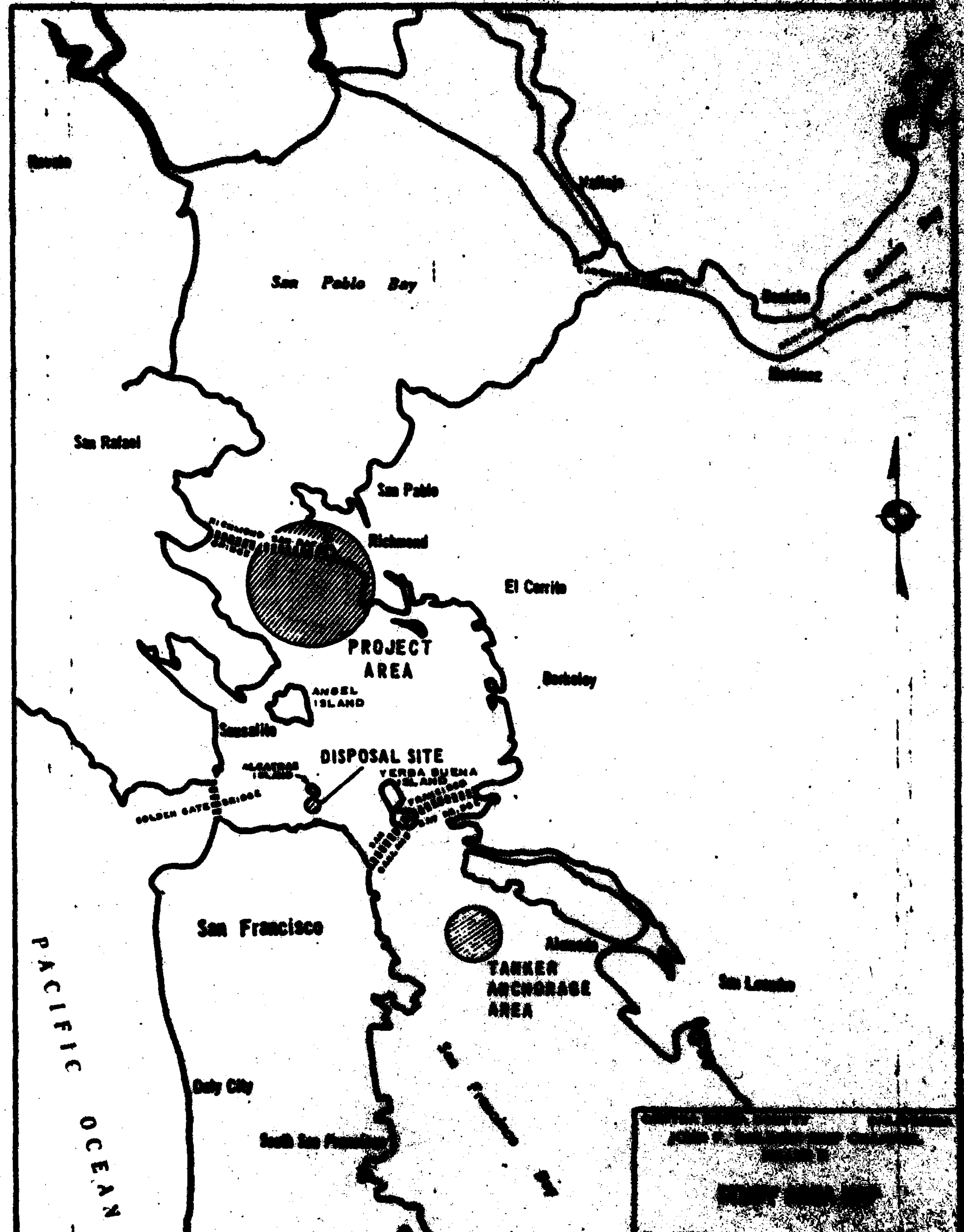

San Pablo Bay
San Rafael
San Pablo
Richmond
El Cerrito
PROJECT AREA
ANGEL ISLAND
Sausalito
DISPOSAL SITE
YERBA BUENA ISLAND
GOLDEN GATE BRIDGE
San Francisco
TANKER ANCHORAGE AREA
Daly City
PACIFIC OCEAN

TABLE III-2

ELEMENTS IN THE ENVIRONMENTAL RELATIONSHIP MATRIX

[illegible] - The surface features of the study area.

[illegible] - Submerged topography.

[illegible] - Hazards stemming from the geology, such as seismic [illegible] and [illegible].

[illegible] - Quality of the water as it pertains to established [illegible].

[illegible] - Movement and mixing of water.

[illegible] - The action of waves.

[illegible] - Removal and deposition of material by water.

[illegible] - Prime farmlands are those whose values derive [illegible] as cropland due to soil and water [illegible] those whose value derives from their [illegible] specialty crops. The designation of [illegible] is made by U.S. Soil Conservation Service.

[illegible] - The condition of the air in and adjacent to, the study [illegible] to support life.

[illegible] - Sound without value.

[illegible] - Free floating microscopic plant and animal life.

[illegible] bottom-dwelling flora and fauna and associated habitat.

[illegible] swimming aquatic animals.

[illegible] vertebrates including man, that bear live young, nurse their young, and have hair over most of [illegible].

[illegible] - Flora and fauna that has been designated as [illegible] State and Federal authorities.

[illegible] - Number of people inhabiting the study area.

[illegible] - Activities by government entities at [illegible]

[illegible] within the study area.

[illegible] community growth is defined as an increase [illegible] in community [illegible] growth is desirable when it is consistent with community goals and values.

Aesthetic Quality - Aesthetics refer to the perception of [illegible] beauty and the judgment involved in deciding what is beautiful.

Cultural Resources - Any building, site, district, structure, object, [illegible] or other material significant in history, architecture, science, [illegible] or culture.

Recreation & Leisure - Any form of play, amusement or relaxation engaged in during leisure time and facilities utilized in such activities.

Boating - Recreational use of boats.

Transportation/Traffic - Transportation is defined as the type, ease and degree of accessibility to desired locations by people from both local and regional points of origin. Traffic is defined as the movement of vehicles along roadways within the study area.

Public Facilities & Services - The availability and adequacy of facilities and services for the public.

Local Government Finance - Tax revenues, bonds, property values, public facilities and public services are some of the component parts of local government finance.

Business & Industrial Activity - Business and industrial activity [illegible] all producers of goods and services - they include all firms engaged in such production.

Natural Resources - Actual and potential forms of wealth existing in nature, including both living and non-living resources.

Manmade Resources - Structures, objects, or sites which have been planned, designed and constructed by man.

Employment/Labor Force - Employment consists of [illegible] in any occupation, business, trade or profession. The labor force [illegible] of all persons 16 years of age and over.

Commercial Shipping - The business of shipping goods by [illegible].

Energy - Power from the burning of fossil fuels, the [illegible] plants, the tapping of geothermal and hydroelectric [illegible] sources such as the wind, the sun, tidal action, [illegible].

[illegible] - The [illegible] regions that are consistent with publicly [illegible].

[illegible] - Community [illegible] of some characteristics providing a [illegible].

[illegible]

PASSIVE ELEMENTS	Topography	Hydrography	Geologic Hazards	Water Quality	Water Circulation	Wave Action	Erosion Sedimentation	Pedology	Air Quality	Noise	[illegible]
PHYSICAL ENVIRONMENT											
Topography											
Hydrography			S				C				
Geologic Hazards											
Water Quality			T		C		T				[illegible]
Water Circulation		S	T			C					[illegible]
Wave Action		T	C								[illegible]
Erosion Sedimentation					S	S					
Pedology											
Air Quality											[illegible]
Noise											[illegible]
BIOTIC ENVIRONMENT											
Plankton				C	M	T					[illegible]
Benthos		S		C	M	T	T				[illegible]
Fish		S		C	M						[illegible]
Mammals									T	T	[illegible]
R/E Species				T					T	T	[illegible]
SOCIO-ECONOMIC ENVIRONMENT											
Number of Inhabitants											[illegible]
Government & Civic Activity									T	T	[illegible]
Land Use	T		S								[illegible]
Desirable Community Growth											[illegible]
Desirable Regional Growth											[illegible]
Community Cohesion											[illegible]
Aesthetic Quality											[illegible]
Cultural Resources						T	T				[illegible]
Recreation & Leisure				T							[illegible]
Fishing						M					[illegible]
Transportation/Traffic											[illegible]
Public Facilities			S						T	T	[illegible]
[illegible]			T								[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Energy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

L E G E N D [illegible]

- C Critical
- M [illegible]
- S [illegible]
- T [illegible]

(b) Benthos.

(1) This resource is considered significant because of its relationship to components of the aquatic food web. Both alternative channel areas and the general area of the disposal site compose this resource. All areas considered for deepening are existing channel routes, including the maneuvering area at Richmond Long Wharf. Associated with the bottoms of the channels and adjacent areas are a variety of marine organisms which include worms, crustaceans, and assorted shellfish. With annual maintenance dredging of existing channels, community stability of marine life is limited. Shoaling of excavated channel bottoms also contributes to unstable community structure in the channel bottom. Several areas adjacent to the Richmond Harbor area are considered potential shellfish seeding areas. No extensive shellfish bed exist in the immediate vicinity of Richmond Harbor, although Brooks Island does support a potential clam seeding area on the eastern shore. Since most areas to be dredged have been previously dredged, deepening is not expected to have a severe disruptive effect upon the bottom. Most, if not all, benthic communitities found in Richmond Harbor channels are expected to be adapted to change. Studies,4/ conducted throughout the Bay specifically for dredging and disposal activities, have shown that recolonization occurs after dredging. This recolonisation indicates the resiliency of the bottom to re-establish itself after excavation.

(2) Benthos supports the larger aquatic life. Anadromous fish, those that travel between freshwater and salt water during part of their life cycle, may be found in waters of the study area. Striped bass, sturgeon and both Chinook and Coho salmon are of this group. The shallow Bay waters also support a variety of estuarine fish including perch, sharks and smelt. Many of these anadromous and estuarine species are important to commercial and recreational sport fishing. All of Central and Northern San Francisco Bay are considered important feeding areas for fishery resources. The vitality of this resource depends on the maintenance of tidal flats and wetlands, and continuing improvement of the quality of Bay waters

(c) Energy.

(1) Improved efficiency in the transport of crude petroleum is a significant resource consideration. The rising cost of energy resources has been of critical concern for the past decade. Further increase in energy use and higher costs are likely in the future. More efficient fuel use by tankers is a significant contribution of the proposed channel improvements. The measure of efficiency are transportation cost savings resulting from the use of larger tankers. Since fuel is a major component of vessel operating costs, as overall costs decrease, fuel costs will also decrease.

(2) Table EIS-3 displays the impact of detailed plans on significant resources and plan economics. Details which describe the significant resources and the environmental effects may be found in Section 5.00. Environmental Effects.

4/ [illegible] Study San Francisco Bay and Estuary, [illegible] San Francisco District, [illegible]

Table [illegible]

COMPARATIVE IMPACTS OF ALTERNATIVE PLANS

Significant Resources

ALTERNATIVE PLANS	WATER QUALITY	[illegible]	[illegible]	[illegible]	[illegible]
No Action, maintains -35' channel depth	O&M Dredging 82,000 cy Alcatraz disposal	Maintenance of existing resources values	Increasing lightering activities and tidal delays	N/A Annual Maintenance costs	Maintenance of existing access and operational limitations
Deepen Southampton Shoal Channel -45' depth	New work dredging 7.9 million cy Alcatraz disposal Increase in annual O&M 53,000 cy	No change in existing resources values	Decreased lightering activities and tidal delays, short route	First Cost $43,150,000 B/C 2.7/1	Improved access and reduction of operational limitations

7.7 [illegible]

This subsection evaluates the effects of [illegible] described significant resources. As [illegible] the comparative impact Table III-7. [illegible] explain the relationship of effects resulting from the [illegible] and identifies the significant effects. The discussion [illegible] differences in degree of impact between the plans.

7.01 Water Quality.

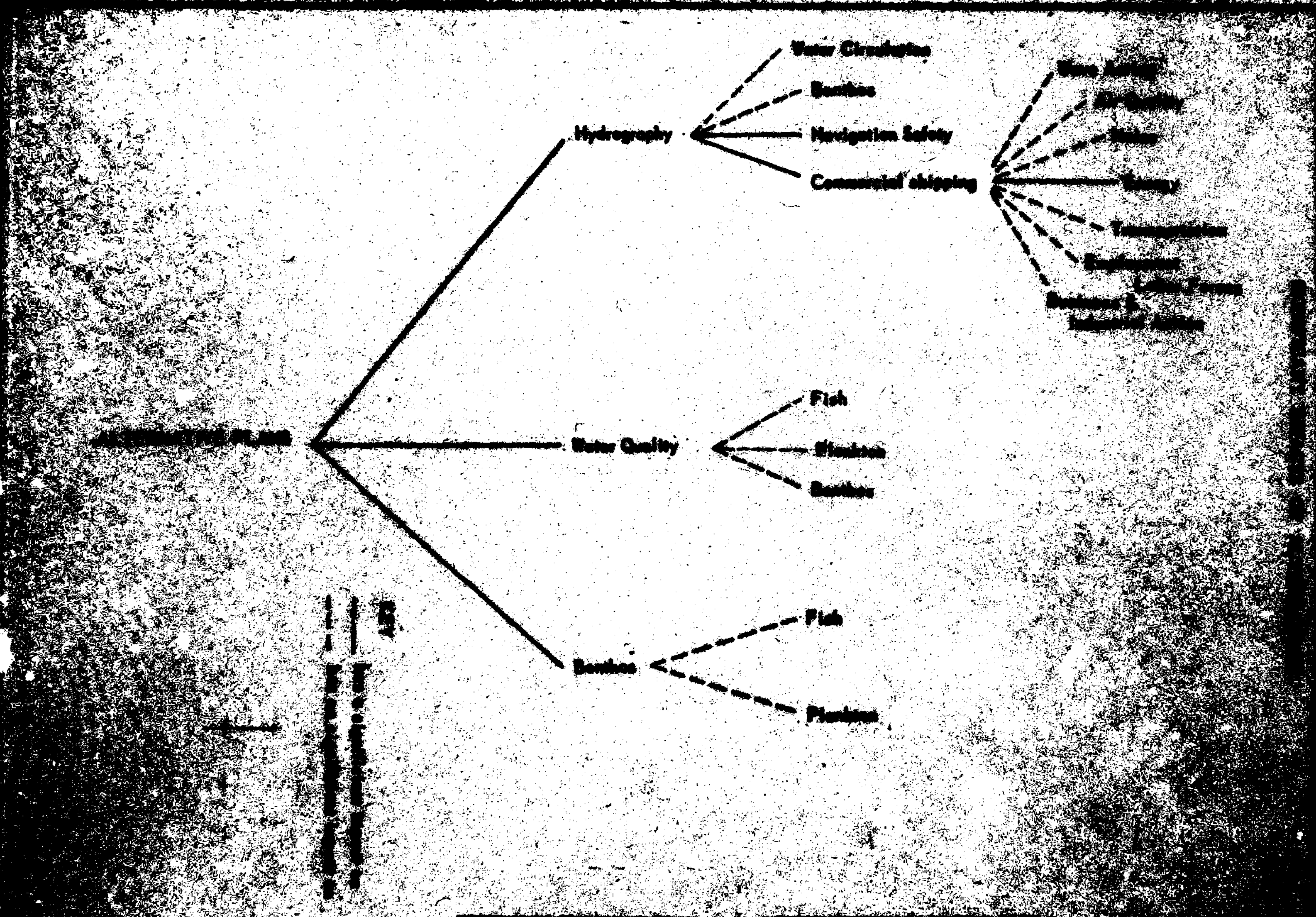
(a) Type of Effect.

(1) The short-term, turbidity impacts resulting from [illegible] disturbance of dredging and aquatic disposal are unavoidable. The [illegible] and temporal extent of turbidity plumes resulting from disposal are [illegible] the type of dredge used and on physical factors such as currents and [illegible]. Duration of the turbidity resulting from a one time disposal [illegible] is typically less than 15 minutes but may last up to an hour in low salinities. Since disposal would occur at the Alcatraz site, material dispersion and dilution would be expected to occur within several minutes. Disposal of dredged material by bottom-dump barge would be [illegible] and localized. Turbidity at the dredging site is continuous as long as the dredge is working. Turbidity resulting from dredging, however, is small scale compared to disposal turbidity.

(2) Associated with sediment disturbance are certain temporary chemical changes in the water column. Since Bay mud is typically in an oxygen deficient state, oxygen is taken from the water column when the sediment is resuspended during disposal. This oxygen reduction in the water is localized at the disposal site and is short-lived. Toxic substances also [illegible] with Bay sediments have not been found to be readily released from sediment attachment and into the water column (see Appendix [illegible], Table 1). Chemical constituents that are released into the water column are not of such concentrations as to degrade water quality at the disposal site.

(b) Effects of Alternative Plans.

(1) No Action Plan. The Central Bay [illegible] which tend to maintain good water quality [illegible] the Bay. Salinity values are affected [illegible] from the ocean. Dissolved oxygen [illegible] due to increased treatment of [illegible] into the Bay. Long-term [illegible] expected to occur as [illegible] any major pollutant spills [illegible] governing water pollution [illegible] of water quality [illegible] turbidity in Central Bay [illegible] [illegible]



Hydrography
Water Circulation
Benthos
Navigation Safety
Commercial shipping
Water Quality
Fish
Plankton
Benthos
Benthos
Fish
Plankton

transport. The remaining seventy percent becomes part of the resuspension-circulation-redeposition within the Bay. Maintenance dredging of the existing project would continue under no action. Impacts of this dredging and disposal on water quality would not be significant.

(2) Plan 1: Southampton Shoal Channel and Richmond Long Wharf. Salinity studies conducted for determining changes in the Suisun Bay and Delta areas have indicated that deepening channels in the central San Francisco Bay would have little effect on increasing salinity intrusion to these upland areas. The Central Bay experiences swift currents that aid exchanges between ocean inflow and Delta outflow. The deepening of the Southampton channel in this area would not exhibit different water quality characteristics than the without project condition. Construction of the Southampton Shoal Channel and Richmond Long Wharf Maneuvering Area would result in about 7.[illegible] million cubic yards of material to be dredged. Maintenance dredging would increase by about 53,000 cy per year. A slight reduction in the potential for oil spills would result from the reduction in ship movements and lightering activities.

7.02 Benthos.

(a) Type of Effect.

(1) During dredging, bottom organisms living in the interface between the water and the bottom substrate would be destroyed or at least displaced from the channel. At the disposal site, some benthos would be smothered by fall out dredged material. The extent of loss, however, is dependent upon conditions existing at the site and total amount of dredged material disposal. The loss of benthic populations would temporarily reduce the biological productivity of the channel areas and any role these areas play in the food web of the Bay. This adverse effect would be unavoidable. This does not mean, however, that disturbed channel areas will be permanently lacking in species or in numbers of individual species. Recolonization of the disturbed areas by bottom species is expected but the composition of the bottom community would be less diverse than that of the adjacent undisturbed areas.

(2) The Alcatraz disposal site is a high energy area characterized by strong currents and scouring of the bottom. Animals residing in this area experience very little burial during disposal because the material is usually quickly dispersed. Nevertheless, if there is some temporary sediment mounding on the bottom, those animals unable to exhume themselves would die. It is expected that actual benthic losses at the disposal site would be minimal since non-mobile bottom organisms are not typical of high energy areas or where there is movement of the bottom substrate. Except for those organisms directly hit by the dredged material, organisms in the water column (plankton and fish) would not be adversely affected.

(3) [illegible] would be [illegible] of the [illegible] and the [illegible] characteristics of the disposal site [illegible] an area of high biological productivity.

(b) Effects of Alternative Plan.

(1) No Action. If the no action alternative is chosen, no dramatic change in benthic productivity of the channel areas would be detected. Maintenance dredging and disposal would continue to have an effect upon the dynamics of benthic populations. The West Richmond Channel is a natural deep-water channel and does not require much maintenance dredging. The Southampton Channel requires only infrequent maintenance dredging, and the Richmond Long Wharf Maneuvering Area would experience frequent maintenance dredging. Dredging disturbances would either limit the productivity of those organisms not tolerable to such conditions and compel adaptation of those organisms tolerant of such conditions. Some degradation of bottom communities resulting from distrubances from the propeller wash of smaller tankers or large tankers plowing the bottom would continue.

(2) Plan 1: Southampton Shoal Channel and Long Wharf Maneuvering Area. Due to the initial dredging the benthic community in the Southampton Channel would be temporarily depressed. However, considering the availability of the open-water habitat and undisturbed bottom habitat of the Bay in the study area, the benthic productivity of the Bay bottom probably would not be significantly affected. Although this plan would have minimal long-term impact upon the Bay ecosystem, deepening the channel would result in localized new disruption to the bottom. The Southampton Channel requires an average of ten feet of excavation to meet the project depth of -45 feet MLLW. Channel and maneuvering areas to be impacted by Southampton and Long Wharf Maneuvering Area total approximately 804 acres. Disposal operations at the Alcatraz disposal site would add to the cumulative disposal amounts already planned from Oakland Harbor, Richmond Harbor and the maintenance of other channels in San Francisco Bay.

7.03 Energy.

(a) Type of Effect. Energy savings to be derived from channel improvements consist of transportation savings of crude oil cargo passing from its source to the Richmond Long Wharf and travel time. Savings in transportation costs would accrue due to the reduction of lightering in transporting crude [illegible], thereby reducing the unit cost of transportation. The [illegible] for each plan is discussed below. The [illegible] project is not considered [illegible].

(b) [illegible].

(1) [illegible] [illegible] delays or lightering. [illegible] tidal delays. At present (1978)[1] [illegible] of all tankers [illegible] Harbor must lighter or wait for higher tide to enter the harbor.

(2) Plan 1: Southampton Shoal Channel and [illegible] Maneuvering Area. This plan would result in traveling [illegible] increase transportation efficiency. The Southampton Channel [illegible] access to the Long Wharf. If the improvements had been in place [illegible] of all tankers calling at the Richmond Harbor in that year [illegible] without lightering or waiting for tides. Thus this plan would [illegible] increase the number of tankers that could call at Richmond Harbor without lightering or tidal delays.

7.04 Other Considerations.

Effects of the plan implementation on other important factors, including those in the socio-economic environment and the physical environment, would also occur. These factors include navigational safety, crude petroleum shipping and hydrography, and have been identified on the impact tree (Figure [illegible]). The impacts on these factors in association with the alternative plans for navigation improvements, are discussed in the following sub-sections.

(a) Navigational Safety.

(1) Type of Effect. Navigational safety is a concern which has been directly identified as one of the planning objectives. Navigational safety has both first-order and second-order environmental [illegible]. First - order environmental impacts [illegible] passage through a channel. [illegible] indirect [illegible] of human well-being [illegible] example of the second order type of [illegible] stress in the natural environment of an oil spill [illegible] or grounding of a tanker. The risk of [illegible] [illegible] [illegible] [illegible] additional [illegible] as discussed below.

[1] [illegible]

(2) Effects of No Action. Under the no-action condition, increased lightering operations and lightering traffic would increase the probability of navigation accident in the Central Bay by concentrating tanker traffic in the shipping hub of San Francisco Bay.

(3) Effects of Action Plan. The action plan provides sufficient widths to allow one-way passage of the largest ships presently calling at the Richmond Long Wharf. The Southampton Channel route is considered a safe route because it does not require any passage through any obstructions to navigation.

(b) Commercial Shipping.

(1) Type of Effect. Crude petroleum shipping is the direct beneficiary of the proposed improvements. By implementing navigation improvements, the efficiency and safety of shipping crude petroleum would be increased as reflected in the planning objectives. Important savings due to the reduction in transportation costs would be realized by providing less dependence on the use of lightering vessels. The economic benefit to be gained would be the reduction in shipping costs for all crude petroleum imports moved through the waterway.

(2) Effects of No Action Plan. Without provisions for navigation improvements, continuation of tidal delays and increased lightering activities would take place.

(3) Effect of Action Plan. By implementing the Southampton Shoal alternative, the number of tankers calling at Richmond Harbor without lightering or tidal delays could be increased by 38% (1979 Data). The Southampton Shoal Channel would continue to be the primary route to the longwharf, but with an added margin of safety for ships 40 feet in draft and larger.

c. Hydrography.

(1) Type of Effect. Hydrography refers to the physical characteristics of the submerged bottom. Any proposed channel dredging would result in changes to the bottom. In the San Francisco Bay system, dredged shipping channels are out of equilibrium with the natural sedimentation processes. Sediment settling in deepened channels may be derived directly from sediment inflow to the Bay or it may be the result of the resuspension-recirculation-redeposition cycle. Shoaling rates in the dredged channels are not constant but vary from year-to-year, depending on the variable sediment inflow volume, wind-wave action and current velocities. During wet years with exceptionally high sediment inflow into the Bay, dredged channels normally experience higher sedimentation rates than in dry years. While current velocities in dredged channels work to remove sediment, they usually are not great enough to remove all sediment. For these reasons, sediments tend to accumulate in navigation channels until they are dredged.

(2) Effects of No Action Plan. The depth of the existing navigation channel is -35' MLLW. Annual maintenance dredging of the maneuvering area is expected to continue at 70,000 cy per year. The Southampton channel is more or less self-maintaining because of swift current velocities. Minor maintenance dredging (12,000 cy per year) is performed by the Corps on an as needed basis. Existing hydrographic conditions would not change.

(3) Effect of Action Plan. Based on the experience with the existing project it is expected that there would be minor increase in shoaling rate due to -45 foot depth in the channel areas. The Southampton Channel is in alignment with the San Pablo Strait and therefore subject to high current velocities with little or no cross-current. Maintenance dredging requirements for the project are expected to be 135,000 cy annually.

7-8 PUBLIC INVOLVEMENT

(a) Public meetings and conferences have been conducted throughout the studies of the John F. Baldwin Ship Channel and of navigational improvements of Richmond Harbor to maintain coordination and obtain input from the general public, local sponsors, and Federal and non-Federal interests.

(b) In September 1977, the San Francisco District completed an environmental and economic status report on the authorized project which was made available to the public for review and comments. A public meeting was held on 16 October 1979 which presented the current John F. Baldwin Study results to the Contra Costa Board of Supervisors and the Contra Costa Development Association. Both indicated support for the completion of all environmental studies on the various channel projects and for early construction of those portions found to be environmentally sound. Another presentation to the Association's Navigation and Shoreline Development committee was held on 13 February 1980 to discuss the Corps' studies on an underwater sill in the Carquinez Straits to reduce salinity intrusion in connection with the Baldwin Ship Channel project. A Scoping Meeting with interested agencies was conducted by the District on 14 April 1980, to begin the preparation of this Environmental Impact Statement.

(c) The U.S. Fish and Wildlife Service by a Planning Aid Letter (See Appendix C) recommended ebb tide disposal to minimize environmental impacts. The Corps is evaluating ebb tide disposal for this project, but so far has not been able to justify the additional $3.7 million in project costs required for ebb tide disposal procedures. The Fish and Wildlife Service has been requested to provide a supplement to the Planning Aid Letter detailing the specific environmental benefits of ebb tide disposal.

(d) Comments Requested. Comments are being requested from the following Federal, State, Regional, County and City agencies as well as environmental groups and interested individuals:

A. **Federal.**

U.S. Department of Agriculture
    Soil Conservation Service
U.S. Department of Commerce
    San Francisco Field Office
    National Oceanic Survey, NOAA
    Economic Development Administration
    Maritime Administration
U.S. Department of the Interior
    Bureau of Reclamation
    Fish and Wildlife Service
    Geological Survey
    National Park Service
    Advisory Council of Historic Preservation
    Office of Environmental Project Review
Environmental Protection Agency
    Region IX
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
    Region IX
U.S. Department of the Navy
    12th Naval District
U.S. Department of Transportation
    Bureau of Public Roads
    12th Coast Guard District

B. **State.**

The Resources Agency
State Historic Preservation Office
State Water Resources Control Board, SF Bay Region
State Lands Commission

C. **Regional.**

Association of Bay Area Governments
Bay Area Air Pollution Control District
Metropolitan Transportation Commission
San Francisco Bay Conservation and Development Commission

D. **County and City.**

Contra Costa County
    Board of Supervisors
    Department of Public Works
    Planning Commission
City of Richmond
City of San Pablo
Port of Richmond
Port of [illegible]
Port of San Francisco

E. Environmental Groups.

California Tomorrow
California Wildlife Federation
Contra Costa Shoreline Parks Committee
Ecology Center
Environmental Defense Fund
Friends of the Earth
Golden Gate Audubon Society
League of Women voters
Oceanic Society
People for Open Space
Save San Francisco Bay Association
Sierra Club
Society of California Archaeology
West Contra Costa Conservation League

7-9 LIST OF PREPARERS

Name and Responsiblity	Expertise	Experience
Rod Chisholm Project Management	Environmental Resources Planner; Water Resources Navigation and Environmental Planning	12 years planning and reports San Francisco District
Harry Erlich Study Coordinator	Economist; Navigation and Water Resources Planning	15 years planning and reports San Francisco District
Frank Best Engineering	Civil Engineer; Navigation and Water Resources Project Design	15 years Design San Francisco District
Gary Hershdorfer Economist	Economist; Navigation and Water Resources Planning	13 years planning and reports San Francisco District
Edward Kandler Cultural Resources	Archaeologist; Cultural Resources Management	4 years planning and reports San Francisco District
Lester Tong Biological Resources	Zoologist; Biological Resources San Francisco District	9 years planning and reports San Francisco District
Robin Mooney Report Quality Control	Civil Engineer; Navigation, Water Resources and Environmental Planning	12 years planning and reports San Francisco District
John Sustar Technical Quality Control	Civil Engineer, Navigation and Coastal Projects, Dredging studies	18 years planning and reports Corps of Engineers

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John F. Baldwin Ship Channel
Phase II
Central San Francisco Bay Segment

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1.02	[illegible]	
[illegible]	1.01-2.08	[illegible]	
[illegible]			
[illegible]	1.06	[illegible]	
Selected Plan	1.06	1.05	
Comparison of	Tbl 3 & 4	[illegible]	
Considered in Detail	1.08		
Eliminated from Further Study	1.01	[illegible]	
[illegible]	1.01-2.07	2.03	
[illegible], Existing authorized	1.01	2.02	
[illegible]	2.03	2.03	
[illegible] by Plan		7.12	
[illegible]	2.08	7.01	[illegible]
[illegible]		7.07	
[illegible]	4.03		
Water Quality Control		3.14	[illegible]
[illegible]	2.02	5.01	
[illegible]		EIS-1-xx	[illegible]
Water Quality	2.03	3.01	
[illegible]	4.03 [illegible]		
Chief of Engineers		1.07	
Executive Order 11990		1.06	
Section 404			
State of California		1.13	

JOHN F. BALDWIN SHIP CHANNEL
Benefit Evaluation - Phase II

INTRODUCTION

The following provides an evaluation of project benefits for Phase II of the John F. Baldwin Shipping Channel. These benefits are attributable to savings in waterborne transportation costs expected to accrue through the Phase II modification of the John F. Baldwin Ship Channel designed to accomodate deeper draft vessels. While there are seven petroleum processing facilities (six major refineries) located along the channel, the Phase II portion will provide additional dredging to the Richmond Standard Oil Long Wharf. Improvements of the channel to the remaining refineries are to be investigated in Phase III.

SCOPE AND PURPOSE

The purpose of this appendix is to develop an estimate of the benefits for the Phase II portion of the authorized project in order to determine the degree of economic feasibility: i.e., whether or not the benefits exceed the costs and if so by what extent. In addition to presenting the magnitude of the benefits, this appendix also provides some understanding of the underlying economics of waterborne crude oil delivery operations in San Francisco Bay.

CURRENT SHIPPING OPERATIONS

Oil companies as well as other shippers have learned that there exists a potential for achieving economies through the use of larger ships and combination of ships which can lower the per unit transporation cost. This recognition has led the oil companies to take advantage of economic efficiences by sizing their tankers so as to minimize their unit cost. However, the potential for "Economies of Scale" as this practice is called does not necessarily result in the use of the largest technically feasible tankers. Other factors such as quantities needed, refinery capacity, production rates, storage costs, as well as channel depth constraints need to be considered in selecting the optimal, not largest, tankers.

An investigation of recent shipping operations, reveals the following general pattern of deliveries to the Richmond Refinery: 80,000 and 120,000 DWT tankers are used directly from Alaska with lightering in the Bay. For Indonesia crude specially modified 150,000 DWT tankers are typically used; however, rather than coming directly to the San Francisco Bay they are partially offloaded at the company's sister refinery at El Segundo, and then further lighter in San Francisco Bay, before preceding to the Richmond Long Wharf. Finally, domestic crude is delivered from Estero, California in smaller typically 35,000 DWT tankers. Thus, several different basic tankers plus lightering vessels are all used concurrently to service the Richmond Long

Wharf, each considered optimal for its particular use. If any of th. conditions underlying this current pattern were to change, oil companies would be expected to reconsider and perhaps alter the operating pattern and array of tankers used so as to optimize the efficiency of the overall operation.

In the case of the Richmond Long Wharf there is under current design two distinct depths to be considered which promotes a two-stage shipping operation. The first consideration is the 55 foot depth at the Bar - or the entrance to the harbor; the second consideration is the 35 foot shipping channel. This disparity in the depths between the Bar and the internal channel causes complex opertaions to be made and in most cases results in the transfer of crude oil from larger ships to smaller lightering vessels once inside the San Francisco Harbor.

BENEFITS

The benefits for the Phase II portion of the John F. Baldwin are computed to be approximately $5.6 million, average annual, based on transportation savings associated with expected crude oil deliveries to the Richmond Refinery over the 50-year life of the project. These are average annual benefits and are in March 1982 price levels. They are computed at the authorized Federal Discount Rate of 3-1/4 percent. The basis for this determination is presented in the following Sections.

DEVELOPMENT OF PROCEDURE FOR BENEFIT ESTIMATION

In 1973 the South Pacific Division and the North Pacific Division of the U.S. Army Corps of Engineers undertook a study of the deepwater port capabilities along the West Coast. The purpose of this combined effort as stated in the authorizing legislation "was to promote and encourage the efficient, economic and logical development of facilities to accomodate present and future waterborne commerce . . ."1/

In order to estimate the "Economics", that is, the transportation savings that could be realized under various alternative concepts a "Simulation Model of Waterborne Crude Oil Deliveries to the West Coast" was developed.

THE TRANSPORTATION SAVINGS MODEL, DEEPWATER PORT STUDY

The Deepwater Port Study (DWPS) was a major undertaking involving many Divisions of the Corps of Engineers for a 2-3 year period. It produced several reports, one of which was West Coast DWPS, Appendix C, Transportation Economics. Due to the scale and complexity of the study it was decided to invest in developing a sophisticated computer model to simulate crude oil deliveries to the West Coast from various points of origin (supply) and calculate the transportation costs.

1/ Committee on Public Works, H.R., Deepwater Port Study, 12 October 1972.

The computer model, developed specifically for this task, considered every refinery operation located on the West Coast; it grouped the refineries at each port and linked them also by company to permit greater flexibility of the simulated operations. It required specification by company of their sources and quantities of supply. It explicily considered an entire array of tankers (designated by OCE) four different "modes" of delivery (direct, multiport, lightering, lightloading), the use of tidal delays, and refinery operating conditions. Based on a quantification of these considerations, it determined costs and then selected for each company at each port the least-cost method of delivery. Summing up these costs for each company for various alternatives for specified years, yielded the transportation costs estimates for those years.

Today, the shipping operations of the major oil companies (and many other shippers as well) are planned with the aid of computer analyses incorporating a large number of parameters and alternatives. Given the fact that "the Optimal Ship Transportation Model", similar to the industry approach, had been developed by the Corps of Engineers, it was decided to adapt this model for the John F. Baldwin analysis. The necessary modifications were performed, adding key simulation features associated with the John F. Baldwin, jointly by the developers of the original model and members of the San Francisco District. This computer model, the Optimal Ship Transportation Model, became the primary analytical tool used in the analysis of benefits. A specific discussion of its basic features is presented below.

METHODOLOGY

(The following description is taken from the West Coast Deepwater Port Study amended as necessary to reflect modifications and additions developed for the John F. Baldwin analysis. As throughout this appendix, the emphasis is on the Phase II portion of the work.)

Utilizing the concept of the least-cost fleet, savings in waterborne transporatation costs were computed by minimizing waterborne transportation costs for crude petroleum by treating California as a system of harbors. Each port was considered part of a single California operation for each company. For Phase II, involving one refinery located adjacent to the John F. Baldwin Channel (Standard Oil), there is a two-port operation potential--the El Segundo and Richmond refineries.

The benefits attributable to the deepening of the John F. Baldwin were based on the channel's ability to serve the two-port California operation. In other words for Standard Oil the least cost way to deliver crude oil from its supply sources (Indonesia and Alaska) to both El Segundo and Richmond refineries was developed under current (without project) conditions and for the increased depth for the John F. Baldwin to 45 feet. The total vessel operating costs associated with delivering the petroleum needs under these two conditions were computed. The difference in the total operating costs between the with project and without represented the transportation savings benefit attributable to the project.

The composition of the least cost fleet and the transportation costs under each condition were determined by a computer program, the development of which has been discussed previously. The analysis's logic is described below.

For three separate points in time, 1985, 1995 and 2005, the costs of delivery for crude petroleum from each source to each refinery were minimized. For the Phase II analysis involving Standard Oil there were two separate sources of supply used for delivering to the two refineries. Hundreds of possible means of delivery involving different modes and ship size were computed. The computer program was designed to select the least-cost method of delivery.

A five-step optimization process was used. In the first step, projections of oil deliveries from each source were determined for each refinery. Next, the cargo capacity and the cost of delivering oil from each source were calculated for each size ship and for each of the possible modes of transportation. Specific operations associated with the difference in allowable draft between the Bar and the channel to the Richmond Long Wharf were treated in a separate step. Suboptimal solutions with higher unit costs were then screened. In the final step, all the ship sizes and associated cargoes for all modes of transportation which remained were utilized as input to a linear program which solved for the least cost way to deliver oil from each source to its destination. Each of these steps is discussed in more detail below.

STEPS

(1) Determination of Quantities from Sources to Refinery Locations. Petroleum consumption and supply estimates were obtained for crude oil from each source to each service area. These estimates are based on research involving the company, the industry and appropriate State and Federal agencies. The various data were then compared and individual estimates from source to refinery for future years were developed. This overall estimate reflected a general concensus. See "DATA" Section below for added discussion.

(2) Development of Cargo Capacities and Costs. The cost of delivering oil to the West Coast refineries was computed for all possible combinations of modes of delivery for all sizes of ships. Within this step it was necessary to compute the cargo carried by each size ship from each point of origin. Points of origin were either the actual source of oil (such as Indonesia) or the other West Coast port from which the ship was coming. Given the distance to be traveled from the point of origin to the two California harbors, the amount of bunker oil and stores required were computed. Capacity for each size was then computed by deducting the bunker requirements from total ship capacity. For ships with drafts greater than the depths available at the appropriate harbors, the applicable immersion factor was used to compute cargo capacity under these conditions. It was assumed that these ships would be loaded at the source at less than full draft. At the same time costs associated with the remaining modes of delivery were developed.

The first mode considered was full and direct shipment from the source to a single port with a direct return. The second mode permitted light-loading at the source. The third was delivery to two ports from the source by offloading some cargo at the first port, continuing to second port to make final delivery, and then returning to the source. The fourth way of delivering oil to a port was to lighter it in a separate vessel from the other port.

For tankers with drafts in excess of channel depth, calculations were made utilizing tidal considerations. In general the use of tidal delays proved "efficient" (less costly) than light-loading. Under this condition large tankers were allowed to ride with the tide which involved a "waiting period", a specified average time associated with the required number of feet of tide.

(3) The San Francisco Bay Subroutine. The limitations of the current channel in the San Francisco Bay were incorporated at this point into the computer program. In the previous step tankers were permitted in San Francisco Bay if they could pass over the San Francisco Bar maintained at a depth of '55 feet (-55 MLLW); 10 feet of clearance is required between the channel and the ship's bottom to allow for large swells.

To account for the lesser depth constraint in proceeding to the refinery through the shallower channel to the Richmond Long Wharf, separate computer analyses (subroutines) were devised to calculate the added cost.

Since the depth at the Bar is greater than through the channel to the Richmond Long Wharf a second optimization procedure is required. This reflects actual current tanker operations where a "large" tanker will enter the Bay and proceed to a prescribed anchorage where it is met by a small tanker. Some or all of the cargo can then be offloaded onto the small tankers (lighters) at which time the ships proceed to the refinery.

This procedure, then, calculates the added cost of delivery from within the San Francisco Bay to the refinery for each possible tanker using three more modes:

(a) Directly, if channel depth permits.

(b) Partial off loading (lightering); tanker proceeds to refinery.

(c) Total offloading with tanker returning to supply source.

Also considered was the use of tides if the ship(s) required added depth. The least cost mode of delivery--including the cost of the lightering ships--to the refinery was added to the operating costs.

(4) Elimination of Sub-optimal and Infeasible Solutions. The fourth step involved in selecting the optimal fleet was to set aside grossly sub-optimal modes of transportation. This was accomplished by identifying the size of ship which cost the least per ton to deliver the oil directly to the port from

each source. The next step was to determine all ships capable of delivering oil to the berths under consideration and identify those which had a lower cost per ton than the least cost ship for making direct full-load deliveries. Consider, for example, a company with refineries in two port areas importing Indonesia oil. For each port, the most economical size ship making direct deliveries from the Indonesian area was chosen whether it was either fully loaded (Mode 1) or light-loaded (Mode 2).

One additional factor was considered at this point — storage availability. If a ship had capacity greater than 10 days refinery capability, it was not considered feasible to deliver this amount and was excluded from the set of possibilities.

(5) Identification of the Least Cost Mode of Transportation and Fleet. The final step in developing the optimum fleet was to consider these possible low-cost solutions and to solve for the least cost fleet using the simplex method. 1/ The objective was to minimize transportation costs to both ports from each source. The constraints applied guaranteed that at each port, the projected demand for petroleum from that source would be met. The solution possibility set ranged over all sizes of ships, each with associated cargo capacities and costs given the route traveled, the depth at each berth, and the mode of transportation. The solution identified the optimum fleet, the mode of transportation, the number of annual arrivals necessary to meet demand, and the annual waterborne operating cost to transport the petroleum.

COMPUTATION OF BENEFITS

This five-step optimization process was repeated for each source of oil for the Base Case (35 foot channel) and with the 45 foot depth. For each specificed year the transportation costs for the project alternative were subtracted from the base case transportation cost in that year. Analysis was made for three years - - 1985, 1995, and 2005. After year 2005, it was assumed that energy conservation and new energy sources would supply an increasing share of the total energy requirement so that both increases in consumption for energy, as well as possible decreases in domestic oil production, would be offset by these two factors. Therefore, after the year 2005, savings in transportation costs were held constant.

Transportation savings were spread over a 50-year project life, discounted at 3-1/4 percent and brought back to average annual equivalent savings.

DATA

To facilitate the analysis it was necessary to establish initial conditions and develop data based on specific assumptions. When assumptions were made they were supported by detailed background studies to the extent possible. These assumptions are presented below.

(1) Refinery Capacities. The refineries at El Segundo (Southern California) and Richmond were assumed not to increase capacity beyond current

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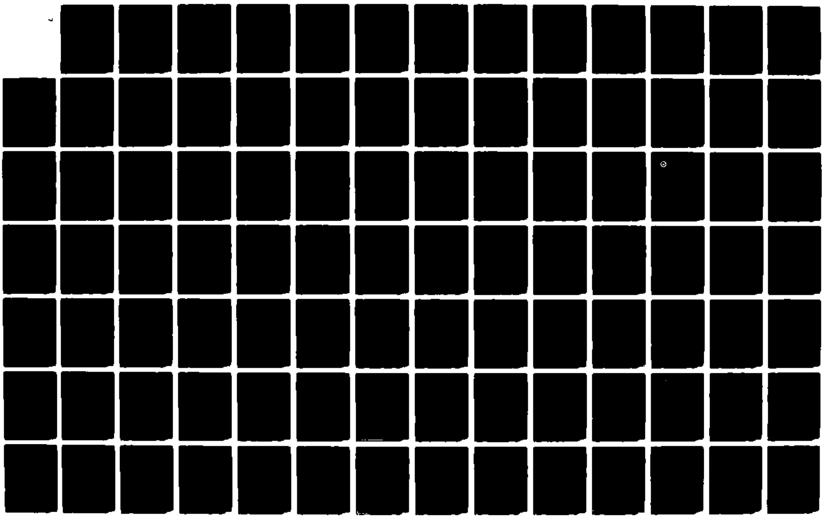

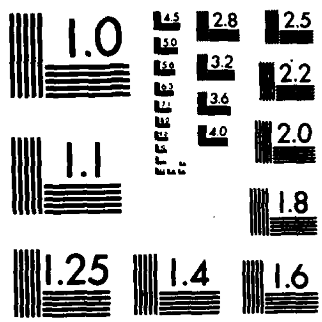
1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

levels. It should be noted that the current output is well below the pre-embargo levels and the these capacities developed at that time should be adequate to produce projected needs.

(2) Commodity Flow (Cargo) Projections. The analyses of benefits significantly depends upon the accuracy to which the future use can be forecast, but the petroleum market has proven to be highly unpredictable since the 1973-74 oil embargo. In fact most experts believe that academically sound projections should not be attempted beyond 1985, the base year of this analysis. In order to develop a reasonable projection, this analysis considers only a 20-year period of growth beyond the base year, 1985-2005. The current market is so uncertain that there would be no real value of more long-range projections; thus, production is the held constant for the project years 2005-2035.

In the projection analysis, the following sources were used: The Department of Energy, Standard Oil representatives, trade journals, and California State Energy Department interpretation of information gathered was applied on a best judgement basis.

CONSIDERATIONS

U.S. oil consumption is generally expected to decrease slightly on a per capita basis to 1995. On the other hand, the growth in population will tend to offset this. Alaskan production has been increasing steadily, but is expected to peak in 1983-1985 and slowly decrease thereafter, barring any new major discoveries.

Some other major developments are: (1) Northern Tier and Isthmus pipelines making it easier to ship Alaskan crude to points east, (2) a glut (probably lasting to 1983-84) of petroleum on the West Coast, and (3) an increase in the amount of California heavy crude through put for the next 30 years. Sources at Standard Oil indicate they will be moving towards greater use of California heavy crude, but will not increase refinery capacity.

On a national level U.S. oil imports are expected to decrease greatly in the future. However, the Richmond refinery has special equipment for blending Indonesian low sulphur crude with the domestic crude. In any case the amount involved is small enough that it will likely remain fairly stable.

According to the California State Energy Office, total petroleum product demand will increase slightly to the year 2000. This is based on the current attitude within the State office at this time. This projection supercedes the State Offices earlier projection presented in their 1981 biennial report which predicted a slight (6%) decrease from 1985 to 2000.

The assumptions underlying these forecasts are steadily increasing fuel prices, increased conservation, and increased feasibility of alternative energy sources. It should be emphasized that these effects must be pervasive to counter the impact of California's growing population and the increased energy requirements this necessitates.

This would indicate that in terms of total throughput capacity, the refineries around the state will change very little. The changes will occur in the types of crude that can be refined. Presently, the major companies are converting to heavier crude refining equipment.

At present, crude going through California refineries comes from three sources: California, Alaska, and Indonesia/Malaysia. The Alaskan and Indonesian/Malaysian crude is brought in on deep draft-operation vessels. California crude is largely transported by pipeline, although oftentimes crude and processed intermediates are transferred by small tankers.

In summary the analysis of the future petroleum market reveals the following major findings.

a. Petroleum is viewed as a very dynamic market with offsetting trends tending to cancel out each other. "Price" for one is expected to increase in real terms (i.e. over and above inflation) which by itself will cause a decrease in demand.

b. The consensus appears to be a steady market or a slight increase at least for the next twenty years.

c. For the particular refinery involved in Phase II (Standard Oil at Richmond), the projection is for a slight increase over the next 20 years. This is based on the fact that it is a very modern facility capable of efficiently using and mixing California, Alaskan and Foreign crudes to meet U.S. Standards.

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Based on this information and cognizant of the fact that the benefit analysis holds oil prices constant, the analysis concludes that a modest (1/2 of 1 percent per year) growth in output is most likely. Other possibilities, no growth, 1% and 2% growth per year, are also included at the end of this section as a sensitivity analysis. The following table presents the actual (1981) and the "most likely" future crude oil shipments for the Richmond refinery.

TABLE 1

ACTUAL & PROJECTED WATERBORNE CRUDE OIL DELIVERIES
RICHMOND
Barrels/Calender Day

	1981	1985	1995	2005-35
Alaskan	120,000	122,400	128,600	135,000
Indonesian	25,000	25,500	26,800	28,000
Domestic	136,000*	136,000*	136,000*	131,000*
Total Production	281,000	284,000	291,000	294,000
Capacity	294,000**	294,000**	294,000**	294,000**

* Estero mix = 24,000; Pipeline = 112,000-expected to ultimately travel entirely by pipeline.

** Actual capacity is 365,000 but held to 294,000 because of Air Control Board restrictions.

EL SEGUNDO
(barrels/day)

	1981	1985	1955	2005-35
Alaskan	140,000	142,800	150,000	158,0000
Indoesian	28,000	28,500	30,000	31,500
Domestic	96,000*	96,000*	96,000*	96,000*
Total Production	243,000	267,000	276,000	285,000
Capacity	334,000**	334,000**	334,000**	334,000**

* Estero mix = 30,000; Pipeline = 66,000

** Actual capacity is 405,000 but held to 334,000 because of Air Control Board restrictions.

Source: Industry Spokesman.

(3) Distances For the long-distance tanker routes from Indonesia, tankers would ply the Great Circle Route.

TABLE 2

Distances
(In Miles)

	Alaska	Indonesia
1. Port to		
San Francisco Bay	1,795	7553
El Segundo	2,109	8042
2. Port to Port		
El Segundo to San Francisco Bay	344	
3. Port to Refinery		
San Francisco Bay to Richmond	9	

(4) Depths at Refineries./Channel. These depths used in the analysis are given in MLLW.

El Segundo	55 feet
At San Francisco Bar	55 feet 1/
At Richmond	
(Current)	35 feet
(With Project)	45 feet

1/ Requires an additional 5 feet clearance under keel beyond stated 5 feet due to large swells.

Source: Distances Between Parts, H.O. Pub 151, Oceanographic Office; Oceanographic Chart; San Francisco Bay Entrance

(5) Depth of Port Facilities At Source

There would be no constraint on ship size that could not be handled at each of the sources since both harbors at the supply end have deep natural harbors.

(6) Ship Characteristics

a. Twenty-one different foreign and 21 different domestic tankers were considered as described in the tables below.

TABLE 3
SHIP OPERATING COST DATA
(FOREIGN)

KDWT	COST @SEA ($ HR)	COST @PORT ($ HR)	DRAFT (Ft.)	IMN. FACTOR (Tons/In.)	SPEED (Kts)	FUEL (Barrels/hr)	TIME IN PORT (Hrs.)
25	1095	771	32.0	92	16.0	365	24
30	1132	806	32.5	104	16.0	365	24
35	1169	842	33.0	115	16.0	365	24
40	1244	889	35.3	124	16.0	391	25
45	1319	937	37.6	134	16.0	418	28
50	1394	984	40.0	143	16.0	445	30
60	1477	1057	41.0	164	16.0	605	70
70	1733	1137	42.0	177	16.0	710	30
80	1883	1192	44.0	208	16.0	710	30
85	1910	1221	45.0	211	16.0	735	30
90	1936	1250	46.0	215	16.0	760	30
100	2004	1307	48.0	225	16.0	773	36
110	2072	4363	50.0	235	16.0	786	36
120	2140	1420	52.0	245	16.0	800	36
130	2225	1468	53.0	261	16.0	842	36
140	2310	1515	54.0	278	16.0	883	36
150	2396	1563	55.0	294	16.0	925	36
175	2598	1705	58.5	307	16.0	991	39
200	2800	1848	62.0	320	16.0	1057	42
232	3033	2021	64.5	360	15.5	1125	45
265	3267	2198	67.0	400	15.0	1189	48

Source: 1981 OCE Vessel Operating Costs (Tankers) updated to March 1982. The fixed vessel costs and the operating costs were updated by the factor 1.12 based on the transportation index from January 1981 to March 1982; the fixed costs used was $29/barrel.

TABLE 3 (Cont'd)
SHIP OPERATING COST DATA
DOMESTIC

KDWT	COST @SEA ($ HR)	COST IN PORT ($ HR)	DRAFT (ft)	IMM FACTOR (TONS/IN)	SPEED	FUEL CONS.	TIME IN PORT
25	2014	1687					
30	2086	1760					
35	2159	1833					
40	2283	1933					
45	2415	2033					
50	2543	2133					
60	2820	2274	(Other characteristics are the same as Foreign Ships)				
70	2956	2359					
80	3081	2439					
85	3153	2490					
90	3226	2540					
100	3354	2657					
110	3483	2774					
120	3611	2891					
130	3772	3014					
140	3833	3137					
150	4094	3261					
175	4460	3567					
200	4827	3874					
232	5254	4241					
265	5681	4608					

Source: 1981 OCE Vessel Operating Costs (Tankers) updated to March 1982 including cost of bunker fuel.

U.S. Ships were used in the analysis of the Alaska oil due to the Jones Act (1920) which required all domestic trade to be shipped on U.S. vessels. Similiarity, "lightering" was accomplished with domestice tankers. The Foreign ships which operate at lower cost were used in the analysis of Indonesia oil shipments.

(7) Tidal Conditions. The tidal delays associated with additional feet of tide are developed from tidal curves of the San Francisco Bay. These conditions were applied both at the Bar and for the channel.

To Obtain	Requires (On Average)	
1 foot	0.2	Hours
2 foot	0.8	"
3 foot	1.5	"
4 foot	2.5	"
5 foot	3.6	"
6 foot	12.0	"

SOLUTIONS

The optimal (least cost) solutions reflecting both the existing channel improvements and the proposed improvements are presented below. These solutions are based on the results of the transportation cost model and represent lowest cost means of delivering the alloted amounts of crude oil to Richmond.

1. From Alaska

The optimal solution under current depths (35 feet) calls for the use of 140,000 DWT from Alaska to Richmond, light load at source to pass over the San Francisco Bar and then lightered further into two small 25,000 DWT tankers to lighter the large tanker sufficiently to pass through the channel. The optimal solution with a 45-foot channel also utilizes a 140,000 DWT tanker to bring the crude pil into San Francisco Bay; however; with the deepened channel only one lighter is required.

2. From Indonesia

The optimal Solution under current depths calls for 150,000 DWT from Indonesia to Richmond with a stop first at El Segundo for partial off loading and subsequent lightering in San Francisco Bay. The optimal solution with the John F. Baldwin 45 foot channel reduces the lightering as shown in Table 4.

These optimal solutions are similar to current operations though not identical. The Indonesian operations are the same with 150,000 DWT and a two port mode; the Alaskan operation utilizes somewhat smaller vessels 180,000 and 120,000 versus predicted 140,000 DWT) and proceeds (as predicted) in the direct one port mode.

TABLE 4

OPTIMAL SHIPS, TRIPS AND CARGO - 1985

Ships (DWT) 1/	Trips Per Year (1982)	Short Tons/Trip to: El Segundo	Short Tons/Trip to: Richmond
1. Base Conditions - 35 foot channel			
a. Supply Area - Alaska			
150,000	48.13	166,600	-
140,000	49.45	-	141,850
25,000 +(2)25,000 lighters			(56,000)
b. Supply Area - Indonesia			
175,000	8.09	181,600	
150,000	9.84	16,100	148,400
(+2 lighters) (25,000, 30,000)			(59,000)
2. Project Conditions - 45 Foot Channel			
a. Supply Area - Alaska			
150,000	48.13	166,000	
140,000	49.45		141,850
(1-25,000 lighter)			(27,000)
b. Supply Area - Indonesia			
175,000	8.09	181,600	
150,000	9.84		148,400
(1 - lighter 25,000)		16,100	(20,000)

Source: Optimal Ship Transportation Cost Model.

Comparision of the Optimal Ship size and the current ships.

The predicted pattern of shipping for the "base case" represents current depths and channel configuration at the Bar and within the Bay. It is, therefore, useful to compare the predicted results for 1985-2035 with the actual 1982 operations. The two waterborne sources expected to continue through the project period are Indonesia/Sumatra and Alaska.

The Indonesian deliveries are identical to the model forecast: With 150,000 DWT tankers using a "two-part operation" with lightering in San Francisco Bay.

1/ DWT is in long tons equaled to 2,240 pounds per ton.

From Alaska the deliveries are direct to San Francisco (identical with the model). A difference with the model, however, is that the actual operation is currently utilizing 120,000 DWTs and 80,000 DWTs versus the predicted 140,000 DWTs.

Given differences between predictive models and the "real world" such differences in results are not considered serious. First of all, the model commences with 1985, not the current year (1982). The optimazation model assumes an equal availability of all ships. In the short run this is not necessarily true. Secondly, the model relies on published costs and other data (OCE) which is derived from average values of several ships; the actual ships available for operation may very from those averages and the costs to specific companies might be different even for the same ship. Finally, the model assumes not only that lightering vessels would be available as needed but for the same costs given by OCE for the small tankers. Possibly this simplification underestimates the real costs for lightering vessels. If the operating costs for lightering are actually greater than used in the model, the tendercy to lighter would be lessened, thus resulting in the use in actually of smaller tankers (less to lighter) than predicted. It should be noted that if the actual costs associated with lightering were greater than used in the project analysis the project benefits would be greater.

AVERAGE ANNUAL BENEFITS

Detailed Transportation Cost Analysis

While the optimal ship transportation cost program (Optimal Ship) provides the least-cost solution to a complex mathematical problem, it does so "without elaboration". That is, many of the specific details associated with the John F. Baldwin solution are not made available as part of its output. In order to identify and display the intermediate results, a second simpler program was written.

The J.F. Baldwin Detailed Cost Analysis program was developed to fulfill a need for more information in the determination of shipping costs for the Phase II study than was available in the existing linear optimal ship program. The two programs are designed to work together. The major distinction between the two programs is that the adopted Deep Water Port Transportation Savings program, given basic parameters, (crude oil demand, ship sizes and their costs, channel depth, etc), determines (using linear programming) the optimal cost ship mix, while the Detailed Cost Analysis program itemizes and displays the transportation costs for any ship mix the user selects.

This second program allows one to choose any ship mix and find the specific transportation costs associated with it. Using the results of this program the total cost underlying the optimal ship selection is better understood. This is meant to be a supplement to the Optimal Ship program and not a substitute.

In the process of optimizing, the Optimal Ship program considers hundreds of possibilities using 21 ships in various combinations and selects the least - cost combination. However, the Detailed Cost Program is better suited for the analysis of different ship mix costs in that it provides detailed results for time and cost of the various aspects of the total transport operation. Thus, once "optional" ships have been selected the Transportation Cost program can provide detailed cost data and sensitivity analysis.

The Detailed Cost Program was developed on the Hewlett-Packard 9830A computer in the BASIC language. The algorithm divides the total trip into time intervals defined by function. For example, the time to load the ship at the source is one interval, the time from source to San Francisco another, and the delay at the San Francisco Bar a third. These intervals are computed for the main ship as well as all the lightering vessels. The time intervals are then multiplied by the appropriate cost per hour factors (either cost at sea or in port) and then summed for the total cost.

In formulating the time intervals, the following factors are considered: vessel speed, fuel consumption, amount light-loaded, wait for tide, time to lighter exclusive of fixed times, tidal affects on speed, and standard time to offload. The vessel data used is current OCE deep draft vessel operating data.

The program is able to compute costs for deliveries to Richmond or El Segundo directly, offloading partially at El Segundo and then coming to Richmond, and various lightering combinations in the San Francisco Bay. The tables presented at the end of the appendix provide the specific cost elements for each of the four optimal trips specificed in Table 6 . Namely under the Basic Condition (35 feet) from Alaska to Richmond Table 11 and from Indonesia to El Segundo to Richmond (Table 12) and under Project Conditions (45 feet) from Alaska to Richmond (Table 13) and from Indonesia to El Segundo to Richmond, Table 14.

Specified from this information the cost for delivered ton to the Richmond Refinery is obtained. As the effects on the El Segundo Refinery are the same with and without the project, the analysis concentrates on the difference in the cost for a delivered ton at Richmond. As can be seen from these tables, the savings involve a reduction in lightering needs with the enlarged channel.

Summarizing this information we can determine that the cost per trip and cost per ton delivered to the Richmond Refinery.

TABLE 5
COST PER TRIP

CHANNEL	ALASKAN	INDONESIA
35'	$1,314,700	$2,706,300
45'	$1,221,700	$2,623,300
Savings:	$ 93,000	$ 83,000
Tons:	141,850	148,240
Savings per ton:	$0.65	$0.56

Source: Detailed Cost Program (actual ships determined in optimi ng program.)

Inserting these savings with the projected tonnage to the Richmond Refinery from each source yields the estimated project savings. These benefits are shown in the following tables.

TABLE 6

TRANSPORTATION SAVINGS

SOURCE:	ALASKA			INDONESIA			COMBINED
	Savings* Per Ton	Tons Per Year (000)	Savings Subtotal (000)	Savings* Per Ton ($)	Tons Per Year (000)	Savings Subtotal ($000)	TOTAL Savings (Undis-counted) ($000)
1985	0.65	6,873	4,467	0.56	1,432	802	$5,269
1995	0.65	7,221	4,694	0.56	1,504	842	5,535
2005-2035	0.65	7,580	4,927	0.56	1,543	864	5,791

*Note: Savings per ton based on the differences in cost per trip delivered to Richmond: 141,850 s.t. from Alaska; 148,400 s.t. from Indonesia.

TABLE 7

ANNUAL DISCOUNTED BENEFITS

YEAR	UNDISCOUNTED SAVINGS	DISCOUNT 3-1/4	DISCOUNT 7-7/8	SAVINGS 3-1/4	SAVINGS 7-7/8
1985	5,269,000	.1636	.2911	$ 862,000	$1,534,000
1995	5,535,000	.2982	.3958	1,650,000	2,191,000
2005-2035	5,791,000	.5382*	.3139	3,117,000	1,818,000
				$5,639,000	$5,543,000

*Note: Factor is sum of factors years +20 to +50.

Sensitivity Analysis on Commerce Projections.

Project benefits are based on the most "probable" future conditions. As such a projected growth rate in crude petroleum use of one-half percent per year is used in the with and without analysis of project benefits. However, risk and uncertainty is also addressed in this section through a sensitivity other analysis of several other levels of projections.

In addition to the base case annual growth rate (one-half percent), other rates were considered. Starting with the current year (1982) projections were made under conditions of "no growth" (zero percent), one percent and two percent per year. As with the base case analysis, projections of growth were made only for the first 20 years of project life due to extreme uncertainty of the basic parameters (price, demand , supply and alternative energy sources.) Since it is not anticipated that the project will induce growth the same projections are used in the with and without cases.

Presented below (Table 8) are the projections of waterborne crude oil deliveries to the Richmond refineries based on four different rates of growth to the year 2005. Table 9 displays the Average Annual Equivalent Benefits for these four projected rates of growth.

TABLE 8

PROJECTIONS in BBls/DAY & S.TONS/YR.
Sensitivity Analysis of Waterborne Projections,
Alternative Projected Future Deliveries, Richmond Refinery.

(BARRELS/DAY)

Annnual Growth Rate	1985	1995	2005-2035
0	145,000	145,000	145,000
1/2%(Base Projection)	147,000	155,400	163,000
1%	151,000	164,700	184,000
2%	157,000	191,000	233,000

(TONS/YEAR)

	1985	1995	2005-2035
0	8,142,600	8,142,600	8,142,600
1/2%(Base Projection)	8,305,500	8,726,000	9,153,000
1%	8,479,000	9,248,000	1,033,000
2%	8,816,000	10,725,000	13,084,000

TABLE 9

AVERAGE ANNUAL EQUIVALENT BENEFITS 1985-2035

UNDER VARIOUS RATES OF GROWTH
SENSITIVITY ANALYSIS

Growth Rate	Average Annual Equivalent Benefits @ 3-1/4% ($000)
0% (No growth)	$5,000
1/2 (Base Case)	5,600
1%	6,200
2%	7,400

APPENDIX B
SECTION 404 (b) OF THE CLEAN WATER ACT
EVALUATION

APPENDIX B
Section 404 (b) of the Clean Water Act
Evaluation

I. Project Description

a. Location.

The proposed disposal site for the dredged material is in open water south of Alcatraz Island in San Francisco Bay. The dredging sites are the connecting channel across Southampton Shoal and the Richmond Long Wharf. See Figure 404-1 for dredging sites.

b. General Description.

The project is described in detail in the Interim Design Memorandum and Environmental Impact Statement.

c. Authority.

The San Francisco Bay to Stockton ship channel was authorized in Public Law 89-298 adopted 27 October 1965.

d. Dredged Material.

1. General characteristics of material. The material from Southampton Shoal is sand. The material from the Long Wharf maneuvering area is a clay loam (average of 3 core samples: 29% clay, 40% silt and 31% sand).

2. Quantity of Material. The initial dredging required for the project is 7.9 million cubic yards. Maintenance dredging is estimated to be 135,000 cubic yards after the project is complete.

3. Source of Material. The material to be disposed would be excavated from the Southampton connecting channel and the Long Wharf maneuvering area. The source of the material is alluvial deposits.

e. Description of the Proposed Discharge Site

1. Location. The proposed discharge site is south of Alcatraz Island in San Francisco Bay with its center at coordinates 37° 49' 17"N and 122°25'23"W See Figure 404-1.

2. Size. The discharge site is circular with a radius of 1000 ft. The surface area of the site is 0.11 square miles. Recent hydrographic surveys of the disposal site indicate a mound of material raising from about -80 feet MLLW to -25 feet MLLW in the eastern half of the site, covering about 25% of the area. At present no disposal is permitted in the eastern half of the site and disposal in the western half is limited to sediments free of debris.

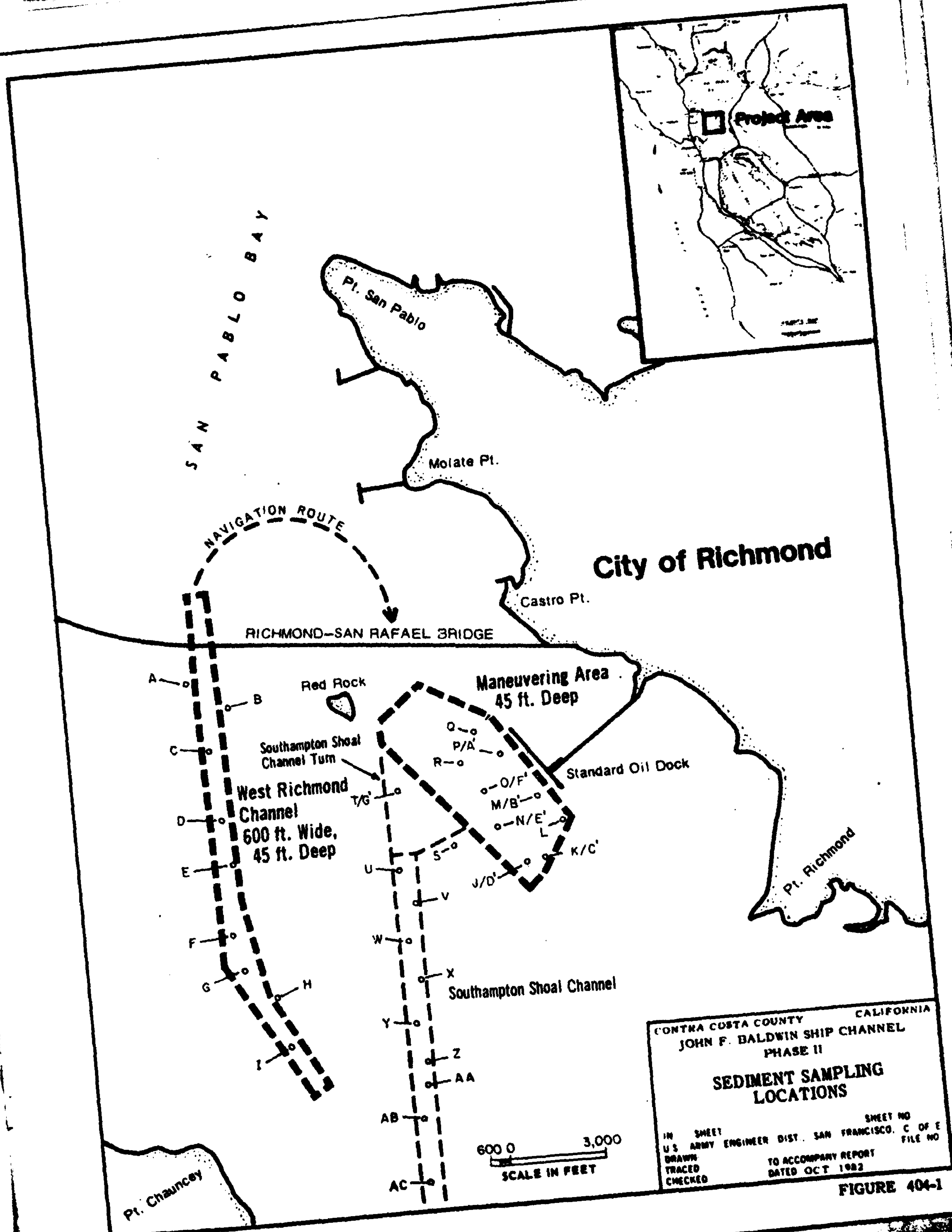

Project Area
SAN PABLO BAY
Pt. San Pablo
Molate Pt.
NAVIGATION ROUTE
City of Richmond
Castro Pt.
RICHMOND-SAN RAFAEL BRIDGE
Red Rock
Maneuvering Area
45 ft. Deep
Southampton Shoal
Channel Turn
Standard Oil Dock
West Richmond
Channel
600 ft. Wide,
45 ft. Deep
Southampton Shoal Channel
Pt. Richmond
Pt. Chauncey
A
B
C
D
E
F
G
H
I
Q
P/A'
R
O/F'
M/B'
N/E'
L
K/C'
J/D'
T/G'
S
U
V
W
X
Y
Z
AA
AB
AC
600 0
3,000
SCALE IN FEET
CONTRA COSTA COUNTY
CALIFORNIA
JOHN F. BALDWIN SHIP CHANNEL
PHASE II
SEDIMENT SAMPLING
LOCATIONS
SHEET NO
IN SHEET
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT
DATED OCT 1982

FIGURE 404-1

3. Type of site. The discharge site is an unconfined open water site with high current energy. There is rapid dispersion of sediment due to the magnitude and extent of currents.

4. Type of Habitat. The natural bottom sediment is composed of coarse sand. Fauna at the site is quite variable, and most animals are transient.

5. Timing and duration of discharge. For the authorized project, dredging is estimated to last 48 months. Dredging would be continous year round. Disposal is to be any tidal cycle.

f. Disposal Method. Disposal would be from a barge or hopper dredge.

II. Factual Determination

a. Physical Substate. Covering of the bottom would be minimal over the long term due to the high energy characteristics of the location. Almost all of the material would be dispersed upon release in the water column. The material impacting on the bottom is expected to be carried away by bottom currents overtime. Model studies of disposal of fine grained material (silt and clay) at the site have shown that half of the material moves out of the bay system through the Golden Gate. Initial movement of the disposed material was predicted by the model as follows:

% Dredged Material	Location
47	outside the bay via the Golden Gate
1	extreme southern end of the south bay
21	between SF international airport and the Bay bridge
27	Central Bay
3	San Pablo Bay
1	Carquinez Strait

The material that remained in the Bay (53%) was deposited principally in the shallow regions of the Bay.

The disposed sandy material would become part of the bedload transport system on the bay bottom and would move between the Golden Gate and Racoon Straights with prevailing currents. Benthic organisms in high energy areas such as the disposal site are sparse and usually adapted to shifting sediments. Due to the small percentage of dredged material that would fall to the site bottom, and the ability of the animals to survive in a shifting substrate, burial of benthic organisms by short term mounding of dredged material would not be significant.

b. Water Circulation, Fluctuations and Salinity Determinations.

1. Water. The proposed disposal activity will not result in any changes in salinity, water chemistry, color, nutrients, odor, or temperature. Monitoring of disposal of dredged material from a barge during the dredge disposal study (DDS) did not indicate that there was any significant change in any of these parameters. However, the monitoring study indicated that the concentration of dissolved oxygen was affected by dredged material disposal. The dissolved oxygen concentration was reduced at the surface by approximately two parts per million and lasted approximately two minutes. Near the bottom of the water column, sediment disposal can cause a significant oxygen depletion with each release. Reductions of up to six parts were million were observed in the DDS. Ambient concentrations were regained after an average of three to four minutes, but could last as long as eleven minutes. The direction and intensity of these fluctuations is determined by the chemical composition of the material, its contactable surface area and by areation resulting from mechanical perturbations during the operation. The duration of the dissolved oxygen reduction is controlled by the contact time between sediment and water and by the intensity of the initial demand.

The turbulent nature of the disposal site and the rapid dilution of the released material will minimize the duration and intensity of the depression. Since the material from the Southampton Channel is primarily sand, the oxygen demand of the sediment should be relatively low. The finer grand material from the Richmond Long Wharf maneuvering area (4.0 million cubic yards) could cause oxygen depressions similar to that detected in the DDS. The impact upon the water column would be intermittant due to discontinuous disposal from the barge or hopper dredge.

2. Current Patterns and Circulation. Strong ambient currents indicate no change in current patterns or velocities or stratification of the water column, has occurred due to dredge material disposal.

3. Normal water level fluctuations. No change in water levels or salinity gradients would occur.

c. Suspended Particulate/Turbidity Determinations

1. The proposed methods of disposal are by barge with bottom dump or hopper. Either of these methods would facilitate the passage of the fine grained dredge sediment through the water column relatively intact. It is estimated that the volume of sediment expected to mix in the upper water column would represent a very small proportion of the total volume (estimated between 1 and 5 percent). The exact amount will depend upon the cohesive properties of the sediment and the interactions of the sediment with the water column. In the lower water column (bottom 2 meters) the sediment load would be greater. Between 50 to 60 percent of the fine grained dredged material that reached this level would be expected to mix with the water column. 10% of the sandy material, such as that extracted from the West Richmond channel or the South Hamptom connecting channel, is predicted to mix with the upper water column, and 20% would be expected to mix with the lower water column.

The duration of each discrete dump would last approximately two minutes; dispersion of sediments from the disposal site occurs in about 15 minutes with ultimate assimulation into the bay sediment regime.

2. No significant effects on chemical and physical properties of the water column are expected from the proposed disposal. Due to the location of the site in an area of high water mass movement, dispersion of sediments occurs rapidly, reducing any concentration of high suspended solids, the duration of dissolved oxygen depressions and the potential for maximum release of any chemical pollutant at any one location.

During disposal, short term effects would be expected to occur with each discharge of the barge or hopper load. Increased turbidity would decrease light transmission and would develop a plume upon release. Primary production by phytoplankton would be reduced, however it is noted that the disposal site is located in an area of naturally occuring high turbidity levels. Direct effects upon nekton (free swimming animals) would be limited to those directly under the disposal vessel. Sight feeders would be indirectly affected by the reduced light transmission.

3. Suspended particulate bioassay testing of the dredged material from the Richmond Long Wharf was performed to determine the potential impacts of the suspended material upon water column organisms. Three marine organisms were assayed, Acartia tonsa (copepod), juvenile Crangon nigricauda (shrimp), and Parophrys vetulus (fish) at various concentrations of suspended dredged material for 96 hours. Survival of Arcartia tonsa and Crangon nigricauda exceeded 50% in all experimental treatments, so the limiting permissible concentration (LPC)[1/] would not be exceeded upon disposal.

For Parophrys vetulus, survival was less then 50% in both the 50% and 100% concentration test treatments. LC_{50} values (the concentration that is lethal to 50% of the test organisms) and 95% confidence limits were calculated and a time concentration mortality curve was plotted from these values. The time concentration mortality curve was compared to the expected dilution of the dredged material at the disposal site after four hours to determine if the LPC might be exceeded in the field.

According to the analytical procedures outlined in the Environmental Protection Agency/Corps of Engineers, "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters" implementation manual for section 103 of Public Law 92-532 (the Manual), it is recommended that the concentration of suspended dredged material not exceed 1% of the lower 95% confidence limit of the LC_{50} curve after initial dilution. The lower 95% confidence limit for the Parophrys vetulus LC_{50} curve was 20%. Therefore the concentration of suspended particulate dredged material (Csp) should not exceed 0.2%. The (Csp) for three dredged material samples was calculated using the following formula:

$$Csp = \frac{Vsp}{Vm} \times 100$$

1/ LPC is a concentration of that will not cause unreasonable acute or chronic toxicity or sublethal adverse effects. The LPC is calculated from the LC_{50} values (Lethal concentration to 50 percent of the sample).

where:

C sp = Concentration of suspended material in percent.

V sp = volume of suspended material (calculated from the volume of material contained in one disposal barge and the percent fine grained sediments in the dredged material.
Vm = mixing volume (calculated using mixing volumes for clay, silt and sandy material as presented in the Dredged Material Disposal Study, Appendix N).

The C sp calculation was made for three representative dredged material cores. The C sp values for all three cores was 0.14%. Since the Csp values were less than 0.2% it is concluded that the disposal of the dredged material would not produce environmentally unacceptable impacts in the water column. The Csp calculations are found at the end of this evaluation.

d. Contaminant Determinations

Core samples were taken of the three channel areas proposed for dredging to the project depth plus allowable overdepth. All core samples that consisted of greater than 20% fine grained material by weight (finer than a standard 200 seive) were subjected to elutriate analysis for the following contaminants: oil and grease, petroleum hydrocarbons, mercury, lead, zinc, cadmium, copper, polychlorinated biphenyls (PCB's) and total identifiable hydrocarbons (TICH). The elutriate tests followed the procedures outlined in the manual. Elutriate results are presented in Table 1 as are the results of the water chemistry anaylsis of the receiving water and the applicable state and Federal criteria. Sediment sampling locations are shown on Figure 404-2. As shown in Table 1, neither state or Federal criteria are exceeded for the following contaminants: oil and grease, mercury, lead, zinc, cadmium, and copper. The detected levels of Polychlorinated biphenyls (PCB's) and total identifiable chlorinated hydrocarbons (TICH) meet state criteria, however the detection limit of the equipment used for the PCB's test exceeds EPA critera. No state or Federal criteria has been established for residual petroleum hydrocarbons, so the detected levels in the dredged material were compared to the ambient water quality at the disposal site. The hydrocarbon levels at both the dredge and disposal sites were below the detection limits of the laboratory equipment used in the tests. It is therefore concluded that disposal of the dredged material meets all the applicable water quality standards.

e. Aquatic Ecosystem and Organism Determinations.

1. Effects on Plankton. The temporary increase in ambient turbidity from disposal will reduce light transmission through the water column which will in turn reduce photosynthesis by phytoplankton. As the disposed material will be rapidly dispersed, the impact will not be significant.

The impact of the suspended material upon a representative zooplankton was tested in the suspended suspended particulate phase bioassay test described earlier. The test did not indicate any significant potential impact upon the species tested (Acartia tonsa).

2. Effects on benthos. As the disposal site is in a high energy area, very little of the disposed dredged material is expected to reach the site bottom. Impact upon benthos is considered insignificant.

3. Effects on nekton. Suspended particulate phase bioassay testing was performed on Parophrys vetulus, a representative bottom fish species. As described under section C.3 above, the test results indicate that the effects of the suspended particulate in the water column upon the fish would meet current regulatory requirements.

4. Effects on Aquatic Food Web. The resuspension of the dredged material at the dredging site for the duration of the construction phase was of concern to resource agencies. Bioaccumulation testing of the dredged material was performed to respond to this concern. Testing was performed for cadmium, copper, lead, mercury, zinc, total identifiable hydrocarbons (including PCB's) and petroleum hydrocarbons.

The Japanese little neck clam Tapes japonica, a filter feeder was used for the test. There were three treatments: the experimental treatment, a reference, and a control. During the uptake phase of the test, in the experimental treatment, the clams were held in reference sediment collected from approximately 1.5 miles southeast of the dredge site. Dredged material was suspended in sea water which was circulated through the experimental tank. In the control treatment, the clams were placed in unpolluted fine grained control sediment and unaltered sea water was circulated through the tank. In the reference treatment, the clams were held in reference sediment and reference sediment was suspended in seawater circulated through the tank. The uptake phase lasted 10 days.

After the uptake phase, the clams were all placed in control sediment in sea water for a 10 day depuration phase. Statistical analysis of the experimantal data did not indicate signficant uptake of any of the tested chemicals in the experimental treatment. The testing did not indicate the potential for bioaccumulation of any of the contaminants tested.

5. Effects on Special Aquatic Sites. The dredging site is an unvegetated subtidal area. The disposal site is subtidal with a sand bottom. The proposed activity will not effect sanctuaries or refuges, wetlands, mud flats, vegetated shallows, coral reefs, or riffle and pool complexes.

6. Threatened and Endangered species. The proposed project will not impact any Federally listed threatened or endangered species. In a letter dated 2 April 1982, the U.S. Fish and Wildlife Service indicated that there are no listed or proposed species within the project area.

f. Proposed Disposal Site Determinations.

1. Mixing zone determination. The dredged material will be sufficiently diluted within the authorized mixing zone (as defined in Supplemental Regional Procedures Evaluating Discharge of Dredged or Fill Material into Waters of the United States, SF COE July 1979) to meet all applicable state and Federal water quality criteria.

2. The proposed discharge will meet all applicable State and Federal Water Quality criteria.

3. Potential effects on human use characteristics. The proposed project will not have an unacceptable adverse effect on municipal water supplies, shellfish beds, fisheries, wildlife or recreation areas.

g. Determination of Cumulative Effects on the Aquatic Ecosystem.

Dredging of navigation channels and discharging at one of the three disposal sites in the Bay, has the effect of redistributing the sediment within the system. Corps estimates of dredged material placed into suspension within San Francisco Bay averaged over a 100-square-mile area is about 400 cubic yards per square mile per day of dredging and disposal. For comparison, the amount of sediment suspended by wave action in shallow water has been estimated to be 6,500 cubic yards per square mile per day (for days when wind is 10 knots or greater).

Roughly 2.5 million cubic yards of dredged sediments are discharged at Alcatraz from current Federal (civil and military) maintenance dredging annually. In addition, as much as one million cubic yards per year of non-Federal dredged material discharge have been recorded at the Alcatraz site. Implementation of several navigation improvement projects in San Francisco Bay include disposal at Alcatraz. The authorized (Phase 2) John F. Baldwin Ship Channel would result in initial dredging of 7.9 million cubic yards over a four-year period. Annual maintenance dredging would result in about 135,000 cubic yards. The recommended deepening of Oakland Outer Harbor Channel would result in initial dredging of about 6.3 million cubic yards over a two-year period. Additional annual maintenance dredging would result in about 300,000 cubic yards. Implementation of navigation improvements for Richmond Harbor channels would result in initial dredging of 7.2 million cubic yards over about two years. Increased annual maintenance dredging would involve about 300,000 cubic yards. Although the greatest increase in the amount of material to be disposed at Alcatraz (FY 86) is about 3.6 times the existing level, the Bay system is capable of assimilating these quantities. The material remaining in the Bay system would be recirculated and redistributed. It should be noted that the disposal activity does not add sediments to the system, but redistributes them and results in the movement of sediment to the ocean. A forecasted schedule of new work and maintenance dredging with disposal at Alcatraz is shown below.

CY IN MILL

Project Name/Year	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90
Current Maintenance	2.3	2.3	2.9	2.3	2.3	2.3	2.9	2.3	2.9
John F. Baldwin (Phase II)			.2	1.9	1.9	1.9	1.9	0.1	0.1
Oakland Outer Harbor				2.3	4.0	0.3	0.3	0.3	0.3
Richmond Harbor						4.0	3.2	0.3	0.3
TOTAL	2.3	2.3	3.1	6.5	8.2	8.5	8.3	3.0	3.6

h. Determination of Secondary Effects on the Aquatic Ecosystem.

The proposed project would eliminate the need for lightering petroleum tankers before they enter the harbor area. The channel would have sufficient width to allow two way passage of the largest ships presently calling at the Richmond Long Wharf. The proposed project would reduce the risk of accidental petroleum spills from lightering or ship collisions or grounding.

All benthic fuana inhabiting the dredged sediments will be removed, leaving the channels in a temporary state of depressed biological productivity. The impact of this dredging on benthos in the work area will be more significant if the West Richmond Channel is dredged, because this area has not been dredged previously. Although natural recovery will eventually repopulate the dredged channels, a slight depression in biological productivity will continue to exist compared to natural levels as the sites will be disturbed by subsequent maintenance dredging operations.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. Two other alternative in-bay aquatic disposal sites could be used for aquatic disposal of the dredged material: SF 10 in San Pablo Bay and SF-9 in Carquinez Strait. Each of these sites is further from the Golden Gate than the proposed disposal site south of Alcatraz Island, SF-11, so a smaller portion of the disposed material would exit the Bay via the Gate. The two alternative sites are also further from the dredging site so would increase transportation costs. Land disposal and ocean disposal of the material were also considered and discussed under Section 2.10 of the EIS. Both of these alternatives are considered infeasible at this time.

c. The proposed disposal of dredged material at the Alcatraz disposal site would not violate any applicable State or Federal Water quality criteria. The discharge would not violate the toxic effluent standards of Section 301 of the Clean Water Act.

d. Use of the disposal site would not harm any endangered species or their critical habitat.

e. The project would not impact upon any Marine Sanctuaries designated by the Marine Protection, Research and Sanctuaries Act.

f. The proposed disposal of dredged material would not result in significant adverse impacts on human health and welfare including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife and special aquatic sites. Significant adverse effects on aquatic ecosystem diversity; productivity and stability and recreational, aesthetic and economic values would not occur.

g. To minimize the potential adverse impact of the discharge on the aquatic system the disposal site has been chosen to maximize the amount of material which would exit the bay via the Golden Gate.

h. On the basis of the guidelines the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

TABLE 1
ELUTRIATE RESULTS

Sample Location	Sample	Oil-Grease	Hydro Carbons	Mercury	Lead	Zinc	Cadmium	Copper	PCB'S	TICH
		Contaminant (mg/l)							ug/l	
West Richmond Channel	A	1-	0.2-	.0001	.006-	.010	0.0010	0.003	-	-
	A	1-	0.2	.0002	.006-	.010	0.0016	0.003	0.035	0.001
	A	1-	0.2	.0009	.006-	.010	0.0013	0.002	0.022	0.001
	D	1-	0.2	.0002	.006-	.010	0.0075	0.002	0.024	0.001
Southhampton Shoal Channel	Y	1-	0.2	.0001	.006-	.010	0.003	0.0030	.025	0.001
Richmond Longwharf		1	0.3-	.0001-	.005-	.001-	.0005-	.005	.05	.001-
	(J-T)	2	0.3-	.0003	.005-	.001-	.0005-	.001-	.05	.001-
		2	0.3-	.0001-	.005-	.001-	.0005-	.002	.05	.001-
		1	0.3-	.0001-	.005-	.001-	.0005-	.004	.05	.001-
		2	0.3-	.0002	.005-	.001-	.0005-	.002	.05	.001-
	M-1	1	0.3-	.0003	.005-	.001-	.0005-	.004	.05	.001-
	M-1	1	0.3-	.0001-	.005-	.002	.0005-	.003	.05	.001-
	M-1	2	0.3-	.0001-	.005-	.001-	.0005-	.004	.05	.001-
	N-1	1	0.3-	.0002	.005-	.004	.0005-	.003	.05	.001-
	N-2	1	0.3-	.0001	.005-	.001-	.0005-	.004	.05	.001-
	N-3	2	0.3-	.0001	.005	.001-	.0005-	.003	.05	.001-
	N-4	3	0.3	.0001-	.005-	.001	.0005-	.004	.05	.001-
	A'	1-	0.2	.0002-	.02	.02	.0002	.009	.0005-	.0005-
	B'	1.5	0.2-	.0002-	.02	.006	.002	.007	.0005-	.0005-
	C'	1	0.2-	.0002-	.03	.002	.003	.007	.0005-	.0005-
	D'	1-	0.2-	.0002-	.03	.004	.003	.008	.0005-	.0005-
	E'	1	0.2-	.0002-	.04	.005	.004	.007	.0005-	.0005-
	F'	1-	0.2-	.0002-	.04	.008	.003	.008	.0005-	.0005-
	G'	1-	0.2-	.0002-	.03	.01	.003	.007	.0005-	.0005-
Disposal Site Water Chemistry	1WC	1	0.3-	.0001-	.005-	.043	.001	.003	.05	.001-
	2WC	1	0.3-	.0001	.005-	.042	.001	.004	.05	.001-
	3WC	3	0.3-	.0001-	.005-	.042	.001	.004	.05	.001-
	4WC	3	0.3-	.0001-	.005-	.044	.001	.003	.05	.001-
	5WC	2	0.3-	.003	.005-	.046	.001	.003	.05	.001-
State Objective		75	-	0.0014	.08	.02	.03	.05	6.0ug/l	
"Ocean Plan for California" (instantaneous maximum)										
EPA criteria		-	-	0.0037	0.668	0.170	0.059	0.023	0.01	-

Federal Register 28 November 1980 (instantaneous maximum)

Calculation of Concentration of Suspended Particulate Phase
at the Alcatraz Disposal Site from a Barge
(Values are from DDS Appendix N)

Note: The predicated disposal volume was calculated from figures for barge disposal since this situation represents the worst case analysis.

Particle size	Mixing volume
clay	8.42×10^4 m^3
silt	1.84×10^6 m^3
sand	7.19×10^4 m^3

Mixing volumes for each core sample (Vm)

Sample A'1-4

$$\begin{aligned}
33\%\ \text{clay} \times 8.42 \times 10^4\ \text{m}^3 &= 2.78 \times 10^4\ \text{m}^3 \\
46\%\ \text{silt} \times 1.84 \times 10^6\ \text{m}^3 &= 8.46 \times 10^5\ \text{m}^3 \\
21\%\ \text{sand} \times 7.19 \times 10^4\ \text{m}^3 &= \underline{1.51 \times 104\ \text{m}3} \\
& \quad 8.89 \times 10^5\ \text{m}^3 = \text{Vm}
\end{aligned}$$

Sample C'1-6

$$\begin{aligned}
36\%\ \text{clay} \times 8.42 \times 10^4\ \text{m}^3 &= 3.03 \times 10^4\ \text{m}^3 \\
51\%\ \text{silt} \times 1.84 \times 10^6\ \text{m}^3 &= 9.38 \times 10^5\ \text{m}^3 \\
13\%\ \text{sand} \times 7.19 \times 10^4\ \text{m}^3 &= \underline{9.35 \times 103\ \text{m}3} \\
& \quad 9.78 \times 10^5\ \text{m}^3 = \text{Vm}
\end{aligned}$$

Sample F'1-5

$$\begin{aligned}
18\%\ \text{clay} \times 8.42 \times 10^4\ \text{m}^3 &= 1.52 \times 10^4\ \text{m}^3 \\
22\%\ \text{silt} \times 1.84 \times 10^5\ \text{m}^3 &= 4.05 \times 10^5\ \text{m}^3 \\
60\%\ \text{sand} \times 7.19 \times 10^4\ \text{m}^3 &= \underline{4.31 \times 104\text{m}3} \\
& \quad 4.63 \times 10^5\ \text{m}^3 = \text{Vm}
\end{aligned}$$

Volume of discharge vessel (V_T) = 5500m^3
Volume of liquid phase in the discharge (Vw) = 3900 m^3
Volume of suspended particulate (Vsp)

$$Vsp = (V_t - Vw)\ \frac{(Pc + Ps)}{100}$$

where: Pc = percentage clay
Ps = percentage silt

for sample A'1-4

$$Vsp = (5500\ \text{m}^3 - 3900\ \text{m}^3) \times \frac{33+46}{100}$$

$$Vsp = 1264\ \text{m}^3$$

Mixing volumes for each core sample (Vm) (cont'd)

Sample C'1-6

$$Vsp = (5500\ m^3 - 3900\ m^3) \times \frac{36+51}{100}$$

$$Vsp = 1392\ m^3$$

Sample F'1-5

$$Vsp = (5500\ m^3 - 3900\ m^3) \times \frac{18+22}{100}$$

$$= 640\ m^3$$

Concentration of suspended particulate phase at the disposal site after initial mining (Csp)

For Sample A'1-4:

$$Csp = \frac{1264\ m^3}{8.89 \times 10^5\ m^3} \times 10^2 = 0.14\%$$

For Sample C'1-6:

$$Csp = \frac{1392\ m^3}{9.78 \times 10^5\ m^3} \times 10^2 = 0.14\%$$

For Sample F'1-5:

$$Csp = \frac{640\ m^3}{4.63 \times 10^5\ m^3} \times 10^2 = 0.14\%$$

RICHMOND LONG WHARF
MANEUVERING AREA

ANALYSIS OF SEDIMENTS

March 1982

AUTHORIZATION

1. Results of tests reported herein were requested by DA Form 2544 No. E86-82-3017 dated 29 December 1981, from the San Francisco District.

PURPOSE

2. The purpose of this study was to determine the amount of specified pollutants in samples of bottom sediments and to determine the grain size distribution.

SAMPLES

3. Sediment samples in plastic tubes and water samples in cubitaners were received on 13 and 15 January 1982.

TEST METHODS

4. a. Elutriate. Cadmium, lead, copper, zinc, mercury, oil and grease, petroleum hydrocarbons, PCB and TICH were run according to "Ecological Evaluation of Proposed Discharge of Dredge Material into Ocean Waters," by EPA/Corps of Engineers. The elutriation was accomplished using compressed air.

b. Particle size, Engineer Manual, EM 1110-2-1906.

TEST RESULTS

5. Data are presented as follows:

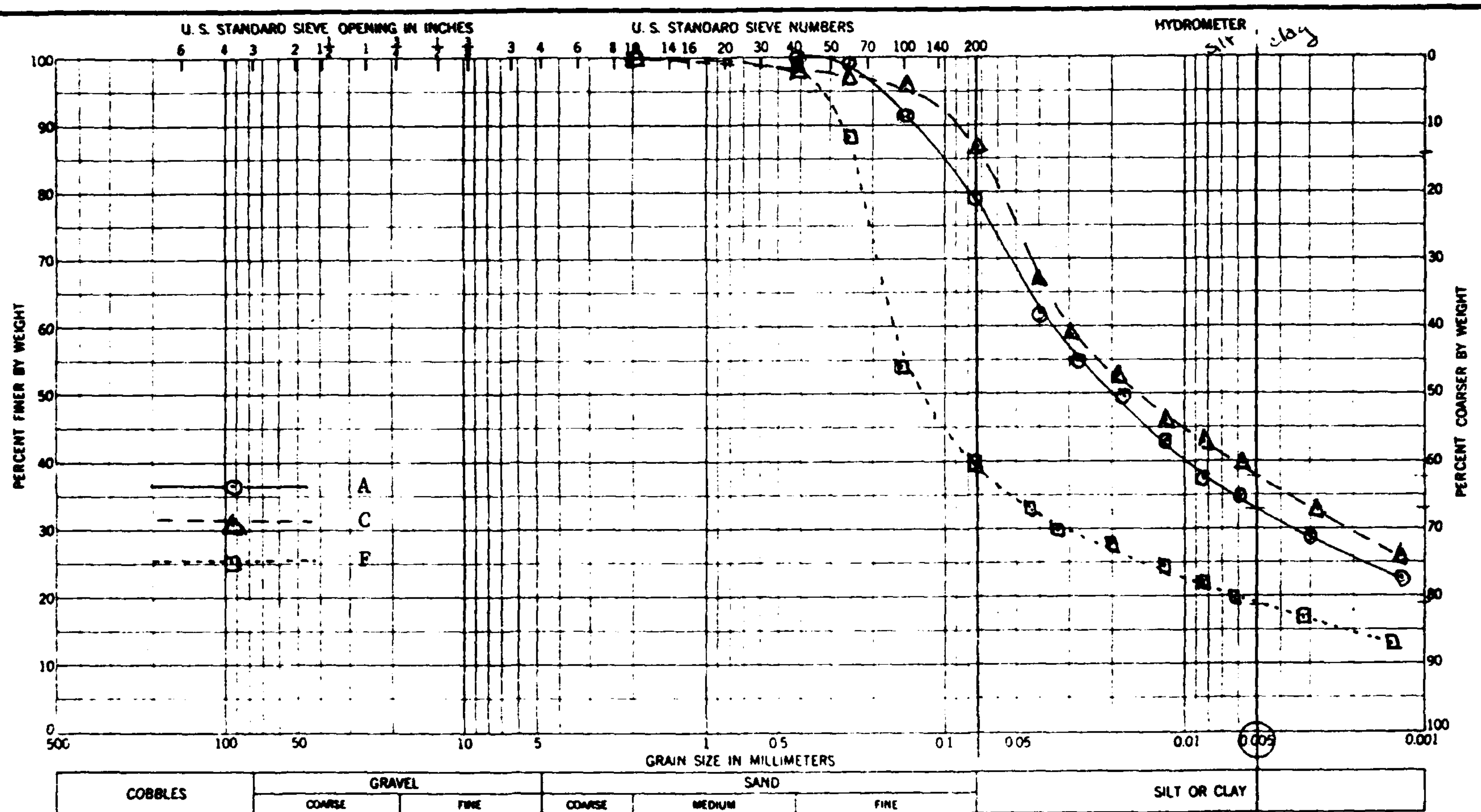
a. The table shows results of the elutriate analysis.

b. ENG Form 2087 shows the grain size distribution.

TABLE 1

LIQUID PHASE CHEMICAL ANALYSIS
OF
RICHMOND LONG WHARF MANEUVERING AREA

	Reported as Milligrams/Liter							Reported as Micrograms/Liter	
Field Sample No.	Oil & Grease	Residual Petroleum Hydrocarbons	Mercury (Hg)	Lead (Pb)	Zinc (Zn)	Cadmium (Cd)	Copper (Cu)	PCBs	Total Identifiable Chlorinated Hydrocarbons (TICH)
A′	1-	0.2	0.0002-	0.02	0.02	0.002	0.009	0.0005-	0.0005-
B′	1.5	0.2-	0.0002-	0.02	0.006	0.002	0.007	0.0005-	0.0005-
C′	1	0.2-	0.0002-	0.03	0.002	0.003	0.007	0.0005-	0.0005-
D′	1-	0.2-	0.0002-	0.03	0.004	0.003	0.008	0.0005-	0.0005-
E′	1-	0.2-	0.0002-	0.04	0.005	0.004	0.007	0.0005-	0.0005-
F′	1	0.2-	0.0002-	0.04	0.008	0.003	0.008	0.0005-	0.0005-
G′	1-	0.2-	0.0002-	0.03	0.01	0.003	0.007	0.0005-	0.0005-



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI

Project RICHMOND LONG WHARF

Maneuvering Area

Area

Boring No.

Date March 1982

GRADATION CURVES

ENG FORM 1 MAY 63 2087

CHEMICAL TESTING

J. F. BALDWIN SHIP CHANNEL

ANALYSIS OF SEDIMENTS

JUNE 1981

AUTHORIZATION

1. Results of tests reported herein were requested by DA Form 2544, No. E86-81-3022, dated 13 May 1981, from the San Francisco District.

PURPOSE

2. The purpose of this study was to determine the amount of specified pollutants in samples of bottom sediments and to determine the grain size distribution.

SAMPLES

3. Sediment samples in plastic bags and water samples in plastic carboys were delivered on 7 May and 3 June 1981, by Marine Research Center.

TEST METHODS

4. a. Elutriate. Petroleum hydrocarbons, oil and grease, PCB, total identifiable chlorinated hydrocarbons, mercury, cadmium, lead, zinc, and copper were run according to "Ecological Evaluation of Proposed Discharge of Dredge Material into Ocean Waters," by EPA/Corps of Engineers. The elutriation was accomplished using compressed air.

b. Particle size, Engineer Manual EM 1110-2-1906.

TEST RESULTS

5. Data are presented as follows:

a. Table I shows the results of the elutriate analysis.

b. SPD Form 66M show the mechanical analysis.

TABLE I

LIQUID PHASE CHEMICAL ANALYSIS
OF
J. F. BALDWIN SHIP CHANNEL

	Reported as Milligrams/Liter							Reported as Micrograms/Liter	
Field Sample No.	Oil & Grease	Residual Petroleum Hydrocarbons	Mercury (Hg)	Lead (Pb)	Zinc (Zn)	Cadmium (Cd)	Copper (Cu)	PCBs	Total Identifiable Chlorinated Hydrocarbons (TICH)
A Grab (Slick)	1-	0.2-	0.0001	0.006-	0.010	0.0010	0.003	(a)	(a)
A Grab (Sand)	1-	0.2	0.0002	0.006-	0.010	0.0016	0.003	0.035	0.001-
A Core 38'-47'	1-	0.2-	0.0009	0.006-	0.010	0.0013	0.002	0.022	0.001-
D Core	1-	0.2	0.0002	0.006-	0.010	0.0075	0.002	0.024	0.001-
Y Grab	1-	0.2-	0.0001	0.006-	0.010	0.0005	0.003	0.025	0.001-

State
Objective

Note: The quantity of samples C Grab and F Grab was not enough to elutriate.

(a) Not enough sample for PCB and TICH.

U. S. ARMY ENGINEER DIVISION LABORATORY--SOUTH PACIFIC

SOIL TEST RESULT SUMMARY

PROJECT: J. F. BALDWIN SHIP CHANNEL DATE May 1981

DIVISION SERIAL NO.	HOLE NO.	CO-ORD OR STA.	FIELD SAMPLE NO.	DEPTH OR ELEVATION FROM	DEPTH OR ELEVATION TO	MECHANICAL ANALYSIS-% FINER: GRAVEL				SAND				FINES		SPECIFIC GRAVITY		
								1/2	3/8	NO.4	NO.10	NO.40	NO.60	NO.200		+4	-4	
810158	A Grab										100	96	89	55			2.71	
810159	A Grab									100	99	95	79	46			2.74	
810160	A Core			38'	47'						100	99	94	67			2.68	—
810161	B Grab							100	97	88	82	76	60	8			2.76	
810162	C Grab									100	97	91	79	22			2.74	$\bar{x}$ % fines
810163	D Grab							100	96	86	75	63	40	6			2.79	= 28.5 West Richmond
810164	D Core										100	97	74	30			2.74	—
810165	E Grab						100	97	85	72	62	51	31	8			2.78	
810166	F Grab									100	97	93	75	36			2.77	
810167	G Grab									100	96	84	39	3			2.75	
810168	H Grab									100	95	27	11	4			2.73	
810169	I Grab								100	99	96	57	17	2			2.73	
810170	U Grab											100	95	7			2.75	
810171	V Grab											100	96	2			2.75	
810172	W Grab										100	94	42	3			2.74	
810173	X Grab											100	84	10			2.76	
810174	Y Grab										100	99	95	48			2.74	

SPD FORM 65M PLATE 1

<— West Richmond —> Southampton

U.S. ARMY ENGINEER DIVISION LABORATORY--SOUTH PACIFIC

SOIL TEST RESULT SUMMARY

PROJECT: J. F. BALDWIN SHIP CHANNEL DATE May 1981

DIVISION SERIAL NO.	HOLE NO.	CO-ORD OR STA.	FIELD SAMPLE NO.	DEPTH OR ELEVATION FROM	DEPTH OR ELEVATION TO	MECHANICAL ANALYSIS-% FINER: GRAVEL				SAND NO.4	SAND NO.10	SAND NO.40	SAND NO.60	FINES NO.200	FINES	SPECIFIC GRAVITY + 4	SPECIFIC GRAVITY - 4	
810175	Z Grab										100	96	59	5			2.74	
810176	AA Grab										100	99	73	3			2.75	
810177	AB Grab											100	94	8			2.73	
810178	AC Grab											100	93	12			2.75	

SPD FORM 65M PLATE 2

CHEMICAL TESTING

J. F. BALDWIN SHIP CHANNEL
RICHMOND LONG WHARF

ANALYSIS OF SEDIMENTS

JUNE 1981

AUTHORIZATION

1. Results of tests reported herein were requested by DA Form 2544, No. E86-81-3018, dated 15 April 1981, from the San Francisco District.

PURPOSE

2. The purpose of this study was to determine the amount of specified pollutants in samples of bottom sediments and to determine the grain size distribution.

SAMPLES

1. Sediment samples in plastic bags and water samples in plastic pails were delivered on 14 April 1981, by Marine Research Center.

TEST METHODS

4. a. Elutriate. Petroleum hydrocarbons, oil and grease, PCB, total identifiable chlorinated hydrocarbons, mercury,cadmium, lead, zinc, and copper were run according to "Ecological Evaluation of Proposed Discharge of Dredge Material into Ocean Waters," by EPA/Corps of Engineers. The elutriation was accomplished using compressed air.

b. Particle size , Engineer Manual EM 1110-2-1906.

TEST RESULTS

5. Data are presented as follows:

a. Table 1 shows the results of the elutriate analysis.

b. SPD Form 66 show the mechanical analysis.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
211 MAIN STREET
SAN FRANCISCO, CALIFORNIA 94105

SPNCO-R

30 July 1979

PUBLIC NOTICE NO. 78-1 (FINAL)

TO WHOM IT MAY CONCERN:

1. The U.S. Army Corps of Engineers, San Francisco District has finalized the supplemental regional procedures for evaluating discharges of dredged or fill material into waters of the United States (Inclosure 1). Public review of the draft procedures were made available by Public Notice No. 78-1 issued on 27 November 1978. These procedures will supplement the Corps' present regulations for evaluating such discharges (33 CFR 323, published in the Federal Register on 19 July 1977) and the EPA's 404(b) guidelines (40 CFR 230, published in the Federal Register on 5 September 1975).

2. Data and test results generated by these procedures are not the sole factors used in deciding whether a permit should be issued or denied by the District Engineer. Data gathered herein would supplement information that we would receive through our public notices on Section 404 discharges. All relevant information that we have would be used to determine whether any given discharge is or is not in the public interest.

3. We would like to emphasize that these procedures are relevant only to waters of the U.S. under the jurisdiction of the San Francisco District, and the testing procedures primarily pertain to discharges of dredged or fill material at open-water disposal sites. Other types of proposed discharge sites (upland, behind-dikes, intertidal areas, etc.) will continue to be evaluated by the regulations cited in paragraph 1.

4. As a result of the comments we received on PN 78-1 of 27 November 1978, announcing proposed changes to our evaluation procedures for Section 404 discharges, and subsequent meetings with various Federal and State agencies, and other interested groups, we have made some modifications to the procedures initially described in PN 78-1 of last November. Some of the changes are: (1) deletion of the liquid phase bioassay; (2) addition of a solid phase bioassay for disposal sites that are low energy areas; (3) use of applicable State water quality objectives (EPA criteria would be used if there are no State objectives); (4) elaboration of the elutriate test; and (5) consideration of modifying the testing procedures for dredged material discharges not exceeding 10,000 cubic yards per activity at any one of the historical open-water disposal sites designated for continual use.

5. The Corps recognizes that most applicants and commercial chemical laboratories are not familiar with these testing procedures since the procedures substantially differ from those that we and other agencies have been using. To insure reasonable time for all those that might be affected by these new procedures, we are allowing a twelve-month "familiarization" period (beginning with the date of this public notice), whereby the Corps in its evaluation of the test results, will take into consideration such factors as laboratory quality assurance, unfamiliarity of the procedures, testing protocol, etc. This twelve-month period will also allow us to work out unforeseen "bugs" in the procedures, and allow the commercial laboratories time to maximize their quality assurance and accuracy of the test results.

6. These supplemental regional procedures for evaluating Section 404 discharges will remain effective until such time they are revised by the Corps, or are superseded by the promulgation of the U.S. Environmental Protection Agency's final Section 404(b) guidelines. Additional details or answers to questions concerning these procedures can be obtained by contacting Mr. Calvin Fong of our Regulatory Functions Branch (telephone 415-974-0416), or by writing to the District Engineer, at the address at the head of this public notice.

John M. Adsit

1 Inclosure
As stated

JOHN M. ADSIT
Colonel, CE
District Engineer
San Francisco District

SUPPLEMENTAL REGIONAL PROCEDURES FOR EVALUATING DISCHARGES OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES

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Inclosure 1 to PN 78-1 (Final)

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TABLES

SUPPLEMENTAL REGIONAL PROCEDURES FOR EVALUATING DISCHARGES OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES*

I. PURPOSE OF THESE SUPPLEMENTAL PROCEDURES

The following supplemental procedures are being offered by the Army Corps of Engineers, San Francisco District, as a guide to applicants for Department of the Army permits for discharges of dredged of fill material into waters of the United States. The purposes of these procedures are to provide revised guidance on the type of information the applicant is required to submit to the Corps of Engineers when contemplating discharge into open waterways, and how the impacts of such discharges will be evaluated (these discharges are commonly referred to as Section 404 discharges in reference to discharges of dredged or fill material being regulated under Section 404 of the Clean Water Act). The procedures outlined herein revise our approach to implementing Parts 230.4 and 230.5 of the Environmental Protection Agency's "interim final regulations" for evaluating Section 404 discharges, as published in the Federal Register on 5 September 1975 (40 CFR 230.4 and 230.5). The 1975 regulations (40 CFR 230 *et seq.*) are generally referred to as EPA's 404(b) guidelines.

*Use of EPA's Ocean Dumping Criteria (40 CFR 220-229, 11 Jan. 1977) will take precedence over these procedures for proposed discharges in ocean waters.

Part 230.4 of EPA's guidelines provides a general approach for EPA and the Corps to evaluate discharges of dredged or fill material, and allows the District Engineer, Corps of Engineers, the flexibility of utilizing the elutriate and/or bioassay tests in this evaluation process. The procedures described herein establish the San Francisco District Engineer's policy for requiring such tests as necessary. Part 230.5 provides guidance on disposal site selection.

The major reason for updating our approach to evaluating Section 404 discharges is that the "bulk sediment" analyses approach does not adequately predict aquatic impacts resulting from dredged material discharge. Several researchers have shown that there is no evidence to support the premise that the bulk sediment composition of contaminants has a relationship with its pollution potential. Additionally, the criteria used to determine the sediment's pollution potential appeared to have been arbitrarily developed for dredged material disposal. In other words, bulk sediment analysis is merely an inventory of the chemicals or contaminants contained in the discharge material; the results are not a measure of potential availability to aquatic organisms or chemical mobility.

In fact, many researchers feel that most of the chemicals associated with dredged sediments are intimately tied into the crystalline lattice of the minerals and are essentially inert or biologically unavailable. The contaminants that are potentially available to organisms are those primarily found in the interstitial waters or loosely connected to the sediment particles. The laboratory procedures described herein somewhat

simulate the mixing action of the discharge material in the receiving water (the elutriate test) and thus measure potential contaminant releases from the discharge. If releases in the elutriate test exceed set water quality objectives or criteria (after considering dilution and mixing), then further tests can be undertaken to measure direct impacts of the discharge material and its associated contaminants on aquatic organisms (aquatic bioassay tests).

These supplemental procedures are to be used in conjunction with the EPA's 1975 guidelines (40 CFR 230) and the Corps regulations (33 CFR 320-329, 19 July 1977) in order to identify and evaluate all public interest factors that might be affected by proposed discharges of dredged or fill material into the aquatic environment. These procedures have been developed primarily to evaluate potential aquatic impacts of discharges at open-water sites, and has only limited application to proposed placement of fill or dredged material along the shoreline, on intertidal areas, beaches, areas behind dikes and wetlands (in other words, non-open water disposal areas). The above type of discharges will continue to be evaluated under the Corps' present Section 404 regulations (33 CFR 323) and EPA's 404(b) guidelines (40 CFR 230).

Since the Corps of Engineers, San Francisco District, developed these procedures, they apply only to Section 404 discharges in waters under the jurisdiction of the San Francisco District. These supplemental regional procedures will remain effective until such time they are revised by the Corps or are superseded by the promulgation of EPA's final Section 404(b) guidelines for discharges of dredged or fill material.

The requirements for descriptive and analytical data as specified in the procedures should be met prior to submittal of ENG Form 4345, Application for a Department of the Army Permit, to the Corps. The application for discharge of dredged or fill material at an open-water site will be regarded as incomplete until all the necessary data are submitted to and evaluated by the Corps. This evaluation will be made prior to issuing the public notice (PN) on the subject discharge, and will be summarized in the PN. In addition to the routine information required in the permit application, a discussion of the "Need for the Project", and a discussion of "Alternative Disposal Methods and Sites" with designation of one preferred alternative must accompany the application. If necessary, biological and economic information of the preferred alternative is to accompany the application. This data will be used in the determination of the acceptability of the proposed disposal operation. If the operation is found to be ecologically unacceptable, another of the prescribed feasible alternatives may offer the solution.

II. INFORMATION REQUIRED FROM THE APPLICANT

A. NEED FOR PROJECT

In Item 6 of the application form (ENG FORM 4345) the applicant must fully describe the proposed project. The description shall include a discussion of the project purpose; the intended use; the source, quantity and description of the material to be discharged; the method of discharge; and the preferred disposal site. Table 1 (p. 8) lists the information that the applicant needs to submit to the Corps. This information is required to evaluate the environmental, engineering, and social implications of the proposed project as opposed to the "no project" alternative.

B. ALTERNATIVE DISPOSAL METHODS AND SITES

1. General Information Required.

Item 14 of the application form is to include a listing of all potential alternative disposal sites. Some of the alternatives the applicant could consider, but are not limited to, are: landfill, diked disposal, material utilization and ocean disposal. If more than one disposal site is being considered, then each site will have to be individually addressed. Next, the applicant must assess each alternative site as to the feasibility of its use. Those alternative sites deemed infeasible should be so designated and a brief explanation presented as to the reason(s) for non-selection (e.g. too expensive, land not available, significant adverse environmental impact, etc.). From the remaining alternatives, one preferred disposal site is chosen.

2. Specific Information Required for Proposed New Disposal Sites.

Proposals to use open-water sites that have not been historically designated for continual use must contain pertinent information necessary for evaluation of site suitability. In addition to providing a chart showing the location of the proposed disposal site, the applicant must submit the following data in descriptive or graphic form:

a. Describe the physical nature of the bottom substrate at the disposal site if it is a low energy area where little movement of the bottom sediments is expected (this might require sediment sampling and analysis); and depth and prevailing currents at the proposed open-water disposal site;

b. Estimate the area that might be influenced by dispersion and transport of the discharged dredged or fill material (this information will be used to estimate the dilution zone);

c. Discuss expected changes, if any, in bottom topography, duration of such changes, potential changes in current and salinity patterns, flushing rates and wave action;

d. Describe any significant aquatic resources in proximity to the area that would be influenced by the disposal operation as estimated in Item (b), above. Aquatic resources include, but are not limited to, sand and gravel deposits, commercial and recreational fisheries, shellfish beds, nursery and spawning areas, important fish migratory patterns and routes, submerged and emergent vegetation, etc. The applicant should contact the California Department of Fish and Game for assistance in identifying the above resources at or near the proposed disposal

site. If such information is lacking, base-line inventory studies may be required on a case-by-case basis;

e. Locate any recreational areas within the estimated area of influence: and

f. Locate any municipal, industrial or agricultural water intakes within 1500 yards of the proposed disposal site.

For San Francisco Bay, new open-water disposal sites will be restricted to an average depth of 30 feet or more (MLLW datum) in order to minimize direct impacts on shallow, mud-flat communities: such as, shellfish beds. If a new site is permitted in San Francisco Bay, it will be conditionally approved to restrict or curtail disposal operations to certain time periods if certain fish or crab migrations or other beneficial uses warrant such restrictions.

New open-water disposal sites will not be allowed to received more than 30,000 cubic yards per activity per year, or more than 50,000 cubic yards per year on a cumulative basis. Applicants are advised to consult with the Corps of Engineers to determine what data are available for any new sites proposed before any studies are initiated.

BASIC INFORMATION

- Project description and location (include appropriate drawings)
- Project purpose
- Location of preferred disposal site
- Source, quantity and description of the discharge material
- Method of discharge

ALTERNATIVE DISPOSAL METHODS AND SITE

- Alternative methods and sites considered
- Economic assessment of alternatives
- If preferred disposal site is not an open-water site approved for continual use, then following information is required: 1/

  Location and depth of preferred new site

  Description of bottom substrate of new site (this might require sediment sampling and analysis)

  Prevailing currents

  Estimate area that might be influenced by the discharge

  Expected changes on the disposal site, if any, after discharge

  Description of aquatic resources in proximity to the disposal site

  Location of recreational areas, municipal, industrial or agricultural water intakes near the disposal site

WATER QUALITY AND BIOLOGICAL INFORMATION (If exclusions do not apply) 2/

- Elutriate analyses of discharge material
- Elutriate analyses of disposal site sediments if proposed disposal site is a low energy area
- Chemical analyses of disposal site water
- Aquatic bioassay results, if required

1/ New sites are limited to maximum of 30,000 cy discharge/activity and 50,000 cy total (cumulative) per year.

2/ For discharges not exceeding 10,000 cy per activity to be disposed of at a historical site approved for continual use, analytical test requirements may be modified on a case-by-case basis.

TABLE 1

C. WATER QUALITY AND BIOLOGICAL INFORMATION

1. Exclusions to Testing.

The applicant is not required to conduct any analytical tests when any one of the following conditions exists:

a. The discharge material is used for beach nourishment or restoration and is composed predominately (80 percent or greater, by volume) of sand, gravel or shell with particle sizes compatible with material on the receiving shores;

b. The dredged material is disposed on an upland/dryland site, and any effluent therefrom is subject to waste discharge requirements by the State.

c. The dredged material is composed primarily of sand, gravel or rock as determined by eighty percent or greater of the material (by volume) being retained on a standard U.S. Sieve Size No. 200 (characteristic of areas with high current or wave energy such as streams with large bed loads or areas with shifting bars and channels), and the disposal site substrate is primarily sand, gravel, or rock;

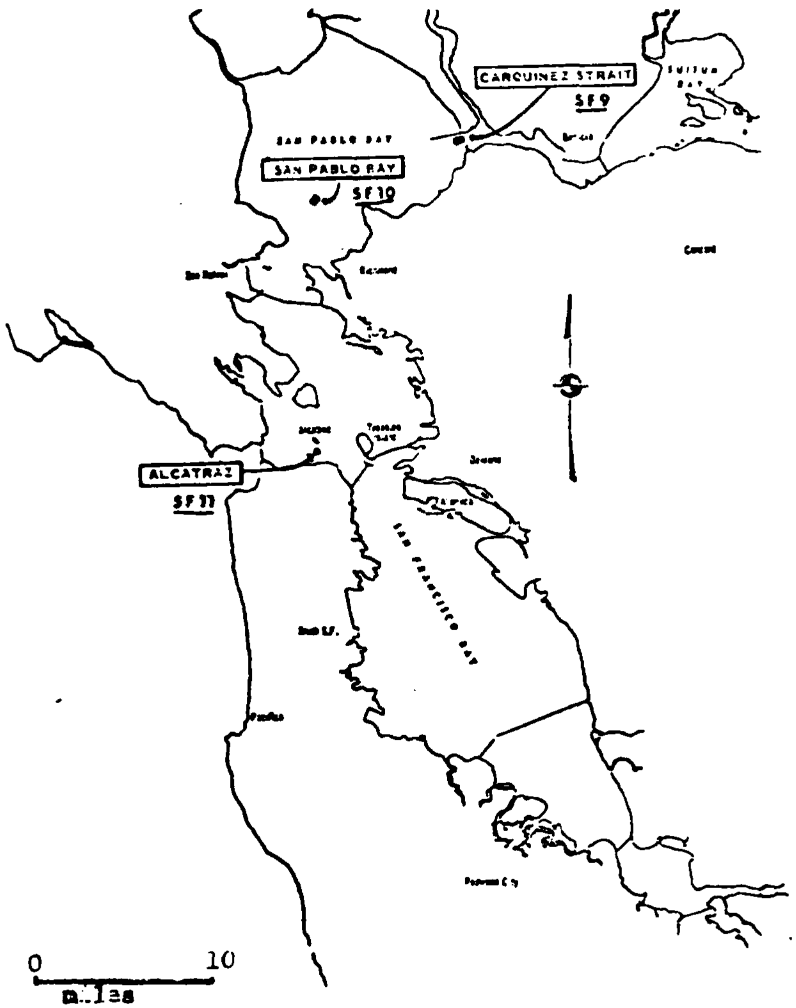
d. The particle size of the proposed discharge material is substantially the same (i.e. classifiable in the same group under the Unified Soil Classification System) as the substrate at the proposed disposal site (if the disposal site is a low energy area) and the site from which the dredged or fill material proposed for discharge is to be taken is sufficiently removed from historical or existing sources of

pollution to provide reasonable assurance that the material has not been contaminated (the distance from known sources of pollution will be determined in each case from prior analysis or information).

Reasonable assurance that the discharge material is not contaminated (a condition of exclusion (d)) can be satisfied if historical data from the dredge or excavation site (such as, elutriate or bioassay data generated over time for a particular dredge and disposal site) show no harm to aquatic life. Maintenance dredging operations could possibly meet exclusion (d) if previous elutriate or bioassay tests show no unacceptable harmful effects at a specified disposal site, and there is no evidence or reason to believe that the chemical quality of the dredged material has substantively changed since the last dredging operation. (The burden of evidence is on the applicant to show no substantive changes in the quality of the dredged material.)

For small dredged material discharges not exceeding 10,000 cubic yards per year being proposed at one of the historical open-water disposal sites approved for continual use (see Figure 1), analytical tests may be modified on a case-by-case basis after consultation with the Corps even though the material may not meet any of the above exclusions. Consideration of modifying the test requirements would depend on the project's purpose, economics, historical sediment quality data (if available), volume of discharge material, as well as other pertinent information.

HISTORICAL OPEN-WATER DISPOSAL SITES
IN SAN FRANCISCO BAY DESIGNATED FOR
CONTINUAL USE



DESCRIPTION OF DESIGNATED SITES

SF 11	ALCATRAZ ISLAND		37°49'17"N, 122°25'23"W
	Distance:		About 0.3 nautical miles so. of Alcatraz Island.
	Depth:		95-160 ft., average 130 ft.
	Size:		Radius of 1000 ft.
SF 10	SAN PABLO BAY		38°00'28"N, 122°24'55"W
	Distance:		2.6 nautical miles NE of Pt. San Pedro at Black & White Buoy.
	Depth:		38-40 ft., average 39 ft.
	Size:		Rectangle 1500 x 3000 ft., long. axis bearing 50° true.
SF 9	CARQUINEZ STRAIT		38°03'50"N, 122°15'55"W
	Distance:		0.8 nautical miles from Mare Island Strait entrance.
	Depth:		28-56 ft., average 42 ft.
	Size:		Rectangle 1000 x 2000 ft., long. axis bearing 80° true.

Datum: MLLW

FIGURE 1

2. Testing Requirements.

If the material cannot be shown to satisfy one of the above exclusion categories (Items (a) - (d)) or the quantity of discharge material exceeds 10,000 cubic yards per year per activity for disposal at a historical site approved for continual use, then testing shall be performed to determine its acceptability for open-water disposal as outlined below. The results of these tests are to be attached to the application form (ENG Form 4345). The testing protocol parallels that required in the Federal Ocean Dumping Criteria (40 CFR 220 et seq, 11 January 1977) in order to maintain consistency in our information requirements for discharges of dredged material, and to enable consistent assessment of the acceptability of proposed discharges into different types of open-water areas (ocean, enclosed bays, tributaries, etc.). The essential elements in the technical procedures are described here; however, for a full description of the analytical procedures, the applicant should consult the Ocean Implementation Manual.* The procedures and methods for sediment and water sample collection, elutriate analyses, and suspended-particulate and solid phase bioassays are essentially unchanged from those specified in the ocean manual. Modifications to the initial mixing zone (referred herein as the dilution zone) calculations and a minor addition to the elutriate test procedure in the manual will be explained in a subsequent section. The laboratory that is to conduct these analytical tests

*Environmental Protection Agency and Corps of Engineers, "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters," published by Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 39180, July 1977. A limited number of copies is available from the San Francisco District.

must have a current State laboratory approved certificate for chemistry and bioassays from the California Department of Health Services, and is advised to contact the Corps to determine if there are any changes or updates to the laboratory testing procedures.

a. Sediment and Water Sample Collection. Collection and preservation of samples will follow the procedures outlined in Appendix B of the ocean manual, except where they have been modified below. A minimum of three random sediment samples should be collected from each sampling site within the dredging or excavation area, and at the disposal site (if it is a low energy area). Selection of sampling sites within the dredging area could be based on proximity of operational discharge pipes, areas of heavy run-off, areas of heaviest shoaling, location of berthing or mooring areas, location of turning basins and channels, etc. In any case, the sampling sites should be located to provide representative samples for the entire area to be dredged or excavated and are to include known or suspected contaminated as well as noncontaminated sites. If there are no basis for designating sampling sites, then sediment samples are to be systematically taken throughout the dredging area. Each sediment sample is to be taken down to the proposed dredging depth (including the over-dredging depth). In order to help the applicant determine the locations of the sampling sites and the number of samples necessary, the applicant is to consult with the Corps.

b. Particle Size Analyses. For each sampling site in the dredging or excavation area the material is to be classified by particle size in accordance with the Unified Soil Classification System. Additionally, if the proposed disposal site is a low energy area (see

Figure 2 for the definition), the sediments from each sampling site at the disposal site are also to be classified by particle size.

c. Elutriate Test. This test will be routinely conducted if the proposed discharge does not meet one of the exclusion categories described earlier or when there is valid reason to suspect synergistic effects of certain contaminants. It is a chemical test that attempts to simulate the interaction of the discharged material with the receiving water or the disposal site bottom after the initial physical effects of dumping have subsided, and it thereby gives a conservative estimate as to the amount of contaminants that could be potentially released or are available to aquatic organisms. Contaminants dissolved in the interstitial water and loosely associated with sediment particles are measured in the elutriate, while those bound to the sediments so tightly that they are not included in the elutriate generally appear to be unavailable to organisms. Thus, in addition to predicting short-term water column impacts after allowance of initial dilution, the test is a general predictor of the potential for long-term leaching and bioavailability of contaminants associated with the disposed material.

Elutriate tests will be conducted on the proposed discharge material using water from the proposed disposal site. Water samples from the disposal site should be typical of the time of disposal, and shall be taken from several stations within the disposal site. The samples will be treated as one composite sample for the elutriate test. If the proposed open-water disposal site is characteristically a low energy area where there is little or no movement of the bottom substate (i.e. minimal dispersion or influence by currents, tides, winds, etc), elutriate tests

will also be conducted on the sediments from the disposal site using disposal site water. If the proposed disposal site is a high energy area where there is substantial movement of the bottom substrate (such as those historical open-water sites shown in Figure 1), elutriate tests on the disposal site sediments will not be necessary. For both types of disposal sites (high and low energy), however, chemical analyses of the disposal site water will be required. Water samples shall also be taken from several stations within the disposal site for these analyses. See Figure 2 for a brief explanation of the testing protocol of the elutriate test.

Contaminants to be analyzed from both the elutriate and disposal site water will include: cadmium, mercury, lead, oil and grease, petroleum hydrocarbons, PCB's and chlorinated pesticides. This list could be revised and expanded upon as necessary by us depending on information relevant to the source and routes of pollution in proximity to a particular excavation or dredging site, testing requirements imposed by updated regulations, and/or by the EPA.

The laboratory procedures for conducting the elutriate tests are to follow the "liquid phase chemical analyses" in the Ocean Implementation Manual except for one addition: the elutriate tests are to be conducted under oxygenated conditions (maintaining oxygenated conditions is not required in the manual for the elutriate test). It is recommended that for the 30-minute mixing period specified in the test procedure of the manual, compressed air be vigorously bubbled through the sediment-water slurry.

SUMMARY OF ELUTRIATE TEST

WHEN ARE ELUTRIATE TESTS NECESSARY?

WHEN THE PROPOSED DISCHARGE MATERIAL DOES NOT MEET ANY OF THE EXCLUSIONS*
--OR--
WHEN THERE IS VALID REASON TO SUSPECT SYNERGISTIC EFFECTS OF CERTAIN CONTAMINANTS

*NOTE: For discharges not exceeding 10,000 cubic yards per activity per year to be disposed of at a historical open-water site designated for continual use, analytical tests may be modified on a case-by-case basis.

ONCE THE ELUTRIATE TESTS ARE CONDUCTED, THEN WHAT?

ELUTRIATE OF
DISCHARGE MATERIAL

▼

COMPARED
WITH

DISPOSAL SITE IS
A HIGH ENERGY AREA 1/

▼

CHEMICAL ANALYSES OF
DISPOSAL SITE WATER

DISPOSAL SITE IS
A LOW ENERGY AREA 2/

▼

CHEMICAL ANALYSES OF
DISPOSAL SITE WATER
- AND -
ELUTRIATE OF DISPOSAL
SITE SEDIMENTS

1/ A high energy area is characterized by substantial movement of bottom sediments due to currents, tides, wind, etc.

2/ A low energy area is characterized by very little movement of bottom sediments (bottom relatively quiescent).

FIGURE 2

The analytical results are to be attached to the application for a Corps permit. Based on the elutriate results of the discharge material, the chemical analyses of the disposal site water and the adopted water quality objectives or criteria for the contaminants of concern tested for, calculations can be made for the total volume of water and shape of plume necessary to dilute the discharge to acceptable levels (this is called the dilution zone). If the concentration of any contaminant tested for in the elutriate is higher (as statistically determined at the 90 percent probability level) than the concentration in the receiving water, and the calculated dilution zone is unacceptably large (i.e. it exceeds the size of the permissible mixing zone), this would indicate that there could be substantial releases of a specific contaminant into the water column during the discharge, and further testing would be required to determine the impacts on aquatic life.

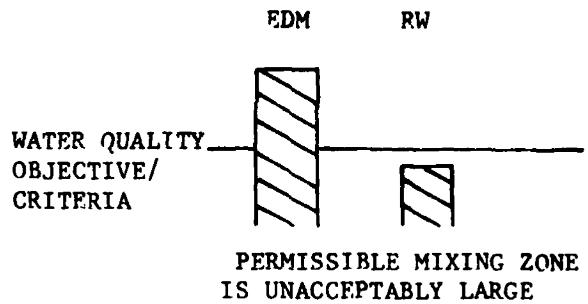
There are two other conditions that would require further testing. One condition would be when the concentration of a contaminant of concern at the aquatic disposal site (i.e. the receiving water) exceeds the adopted water quality objective or criterion, and that same contaminant in the discharge material (elutriate) is higher (90 percent probability level) than that found at the disposal site. This condition would make dilution an impossibility because the ambient level of the contaminant in the receiving water already violates the water quality objective or criterion. The other condition is when there are no established water quality objectives or criteria for particular contaminants of concern. If the elutriate data indicate that for these contaminants

the concentrations are higher (90 percent probability level) than that in the receiving water, further tests would be required to determine the impacts, if any, in the water column. Figure 3 summarizes the three conditions that require further testing. Further testing would be in the form of a suspended-particulate phase bioassay.

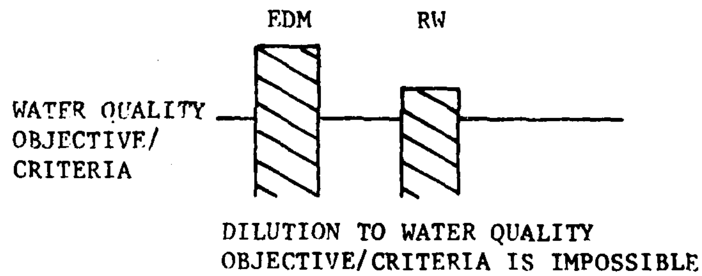
In addition to the above comparison, if the discharge is to occur at a low energy disposal site, elutriate results of the discharge material and disposal site sediments will be compared to determine if they differ statistically from each other. If the concentration of a contaminant in the discharge material elutriate is higher (90 percent probability level) than the concentration in the disposal site sediment elutriate, a solid phase bioassay would be required.

d. Aquatic Bioassays. Laboratory toxicity tests on selected aquatic organisms are termed aquatic bioassays. Rather than rely on numerical comparisons as in elutriate tests, bioassays assess directly the discharge material's impact on live, test organisms by exposing an adequate number of organisms (at least 10 organisms) of each representative species to the discharge material for a set length of time, and then comparing the results (measured in terms of mortality) to a "control." The outcome of the elutriate comparison of the discharge material with either the chemical analyses of the disposal site water or the elutriate of the disposal site sediments would dictate the appropriate bioassay to be conducted.

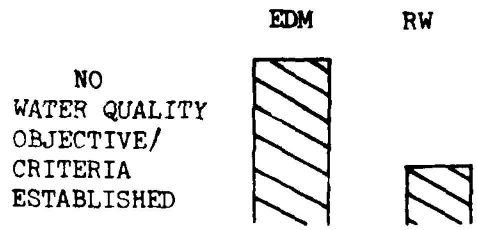
ELUTRIATE ANALYSES: THREE CONDITIONS REQUIRING FURTHER TESTS



Concentrations of contaminants of concern in the elutriate of the discharge material (EDM) are statistically higher* than the concentrations in the receiving water (RW), AND the permissible mixing zone is unacceptably large. A suspended-particulate phase bioassay would be required.



Concentrations of contaminants of concern in the elutriate of the discharge material (EDM) are statistically higher* than the concentrations in the receiving water (RW), AND the receiving water concentrations exceed the water quality objective/criteria; thus dilution to the acceptable level is impossible. A suspended-particulate phase bioassay would be required.



Concentrations of contaminants of concern in the elutriate of the discharge material (EDM) are statistically higher* than the concentrations in the receiving water (RW), BUT no water quality objectives/criteria have been established. A suspended-particulate phase bioassay would be required

*Statistically "higher" is defined at the 90 percent probability level.

FIGURE 3

(1) Suspended-particulate phase bioassay. If the results of comparing the elutriate of the discharge material with the chemical analyses of the disposal site water indicate that the permissible mixing zone will be exceeded (i.e. the volume of water necessary to dilute the contaminants to the adopted water quality objectives or criteria is not acceptable), then a suspended particulate bioassay would be required. This aquatic bioassay is used to predict the impacts in the water column of the receiving water. In other words, it is used to evaluate the effect of dissolved chemical contaminants released from the discharge material and of suspended particulate matter present in the water column for certain periods of time during the disposal operation. Appropriate aquatic test species to be used and the number of replications in the bioassays will be determined by the Corps and EPA in consultation with other pertinent agencies. For details on the bioassay procedures, the Ocean Implementation Manual should be consulted.

(2) Solid phase bioassay. If the discharge of dredged or fill material is expected to stay on the disposal site bottom for any length of time (i.e. a low energy disposal site), and the comparative elutriate results indicate that the concentration of any contaminant tested for in the discharge material is statistically higher at the 90 percent probability level than the concentration in the disposal site sediments, then a solid phase bioassay would be necessary to determine the impacts on the bottom (benthic community). This test provides an indirect indicator of chemical toxicity to and degree of physical compatibility of the dis- charge material with the benthic community around the disposal site. As in the suspended-particulate phase bioassay,

appropriate test species to be used and the number of replications required will be determined by the Corps and EPA in consultation with other pertinent agencies.

A summary as to when bioassays are required is shown in Figure 4. The applicant is to submit to the Corps, along with the bioassay results, the following information: laboratory test conditions (such as, numbers and size(s) of aquaria used, organism acclimation procedure and source of water used during acclimation and test periods); collection procedure for discharge material, disposal site water and sediments; and test organisms used (species, numbers and source(s)).

D. ECONOMIC INFORMATION

This information is necessary not only to establish the need for discharge but will also determine the economic feasibility of utilizing alternative disposal practices. There are several factors which must be included in each economic evaluation. The most important is the monetary loss that would be expected if the project were not accomplished. Supporting information shall include such things as capital costs, induced costs, annual gross and net receipts, taxes, operating expenses, and direct and indirect employment. Discussions of alternative disposal method costs shall include such things as evaluation of increased uses of the facility or increased unit cost for use of the facility as disposal costs increase, mobilization cost of different pieces of equipment, wetland or upland site acquisition cost, and site preparation and operation cost. As a minimum, the economic evaluation should present estimates of total project cost for each proposed alternative.

WHEN ARE AQUATIC BIOASSAYS NECESSARY?

ELUTRIATE OF DISCHARGE MATERIAL
COMPARED WITH CHEMICAL ANALYSES
OF DISPOSAL SITE WATER

↓ ONE OF THREE CONDITIONS IN FIGURE 3 EXISTS

SUSPENDED-PARTICULATE
PHASE BIOASSAY

ELUTIRATE OF DISCHARGE MATERIAL
COMPARED WITH ELUTRIATE OF
DISPOSAL SITE SEDIMENTS

↓ STATISTICALLY DIFFERENT AT THE 90 PERCENT PROBABILITY LEVEL

SOLID PHASE
BIOASSAY

FIGURE 4

III. ECOLOGICAL EVALUATION BY THE CORPS

A. EVALUATION OF THE ELUTRIATE RESULTS

1. The Proposed Disposal Site Is a High Energy Area. A high energy area is an open-water area that is characterized by substantial movement of the bottom substrate due to tides, currents, wind, etc., and may exhibit scouring of the bottom, relatively high dispersion and/or naturally high turbidity. As noted earlier, the open-water disposal sites designated for continual use in San Francisco Bay are considered high energy areas (Figure 1). One would expect that material disposed in such areas would not stay on the disposal site bottom for any length of time but would be dispersed and suspended in the water column. Impacts of concern would thus be centered in the water column at and surrounding the disposal site. The applicant would submit elutriate data for the material to be discharged and chemical data for the receiving water (water from the disposal site).

We would then compare the elutriate data with the chemical data of the receiving water and take into consideration the dilution zone for those contaminants that have pertinent water quality objectives or criteria established. Obviously any time a discharge is added to a receiving waterbody, where the discharge is of different chemical quality than the water, there will be dilution and mixing. The dilution zone is the volume of water at the disposal site required to dilute contaminant concentrations associated with the discharge material to acceptable levels. For marine and estuarine waters, the acceptable levels that we are using are those levels set as water quality objectives by the State Water

Resources Control Board (SWRCB) after consideration of the dilution zone. If the contaminant of concern tested for in the elutriate is not listed with a limiting concentration by the SWRCB, then the pertinent water quality criteria established by the U.S. Environmental Protection Agency (current EPA "Quality Criteria for Water") will be used. As mentioned earlier, in the absence of any established water quality objective or criteria, and the concentration of the contaminant of concern in the elutriate is statistically higher than that found in the disposal site water, a suspended-particulate phase bioassay would be required (see Figure 3).

For freshwater bodies (streams, rivers, lakes, etc.), the acceptable levels are those established in the appropriate regional water quality control basin plans, and which levels would apply would depend on the designated use(s) of the water body in question (e.g. primary designated uses include water supply, agricultural, industrial supply, recreational, shellfish harvesting, etc. and limiting concentrations could vary accordingly). The current EPA "Quality Criteria for Water" will be used if the contaminant of concern tested for in the elutriate is not identified in the appropriate State water quality control plan. As in marine and estuarine waters, where there are no established limits and the concentration of the contaminant of concern is statistically higher than that found in the disposal site water, a suspended-particulate bioassay shall be conducted.

Once the acceptable concentration levels have been determined for the contaminants of concern at a given waterbody, we can calculate the size of the dilution zone for the contaminant of concern requiring the

greatest dilution volume; i.e. the volume of water necessary to dilute the contaminant concentration to the acceptable level. When the dilution zone is calculated, the Corps, EPA, the appropriate Regional Water Quality Control Board, and, as applicable, the San Francisco Bay Conservation and Development Commission (BCDC) will determine whether this dilution zone is of sufficient size to protect or minimize the adverse impacts on the aquatic environment.

a. Permissible Mixing Zones at the Historical Open-water Disposal Sites Designated For Continual Use In San Francisco Bay. Permissible mixing volumes have been determined for the three sites that have been designated for continual use and are dependent on the site, physical properties of the disposal material, and method of disposal. The permissible mixing zone for each of the three sites more or less coincides with the shape of the turbidity (suspended-particulate) plume generated by the specific type of disposal method (hopper dredge, clamshell dredge, hydraulic pipeline with surface release, and hydraulic pipeline with submerged release). The shape of the discharge plume for a given disposal method is more or less the same, irrespective of the disposal site selected, but the dimensions or areal coverage would, of course, differ, depending on current velocity, composition of the discharge material, etc. Based on the Corps' dredge disposal studies in San Francisco Bay, the permissible mixing volumes for the three designated

sites in San Francisco Bay are given in Table 2. Details on how these permissible mixing volumes and their shapes were derived are explained in Sustar's et al paper.*

If the calculated size of the dilution zone is equal to or less than the appropriate permissible mixing volume given in Table 2, then the impacts of chemical contaminant releases from the discharge material are considered minimal. This finding or conclusion would be incorporated into the other public interest factors relevant to making a decision as to whether a Corps permit should be issued or denied in accordance with EPA's September 1975 404(b) guidelines and with the Corps regulations (33 CFR 320 et seq). See Figure 5 (p. 33) for the overall evaluation process. If the dilution zone is larger than the permissible mixing zone, or dilution to the acceptable levels cannot be achieved, or any contaminant in the discharge material elutriate is statistically higher (90 percent probability level) than that in the receiving water (in the absence of any adopted water quality objective or criterion), then the potential effects of contaminant releases from the discharge material are of such concern that we would require aquatic bioassays to determine the impacts (see Figures 3 and 4).

*Sustar, J.F., G. Perry and T.H. Wakeman, "Sediment dispersion from a submerged pipeline," 1978, published in Coastal Zone '78, Vol. II, by ASCE. A limited number of copies is available from the San Francisco District Office.

TABLE 2

PERMISSIBLE MIXING WATER VOLUMES
(Scientific Notation - Cubic Yards)

		Hopper Dredge	Clamshell/ Barge	Pipeline
Alcatraz Disposal Site				
Upper Water Column				
	Sandy	6.6 - 4*	8.2 - 4*	-
	Silty	1.6 - 5	1.0 - 5	-
	Clayey	4.2 - 4	5.4 - 4	-
Lower Water Column				
	Sandy	1.4 - 5	1.2 - 4	-
	Silty	9.2 - 6	2.3 - 6	-
	Clayey	9.3 - 6	5.6 - 4	-
San Pablo Bay Disposal Site				
Upper Water Column				
	Sandy	2.4 - 3	5.0 - 3	9.8 - 4*
	Silty	2.4 - 3	3.6 - 3	1.5 - 6
	Clayey	2.4 - 3	4.3 - 3	1.5 - 6
Lower Water Column				
	Sandy	4.7 - 4	3.7 - 4	3.8 - 5
	Silty	4.1 - 6	6.1 - 5	7.5 - 5
	Clayey	4.1 - 6	1.8 - 4	7.5 - 5
Carquinez Strait Disposal Site				
Upper Water Column				
	Sandy	2.8 - 3	5.8 - 3	9.8 - 4
	Silty	2.8 - 3	4.2 - 3	1.5 - 6
	Clayey	2.8 - 3	5.0 - 3	1.5 - 6
Lower Water Column				
	Sandy	4.7 - 4	3.7 - 4	3.8 - 5
	Silty	4.1 - 6	6.1 - 5	7.5 - 5
	Clayey	4.1 - 6	1.8 - 4	7.5 - 5

(*indicates the exponent of "x10")

Source: Ibid.

b. Permissible Mixing Zone Determination For New Open-water Disposal Sites. Obviously, permissible mixing zones have been calculated only for the disposal sites designated for continual use, since it is impossible to determine where the applicant will select a proposed disposal site. In these new situations, permissible mixing zones will have to be determined on a case-by-case basis by the Corps, EPA, the appropriate Regional Water Quality Control Board, and BCDC (if applicable). The U.S. Environmental Protection Agency, in their "Quality Criteria For Water" publication (1976), suggest that for estuaries, the maximum dimension of the permissible mixing area for effluent discharges should not exceed 10 percent of the cross-sectional area of the waterway. On a given reach of a stream or river, this mixing area should be limited to one-third (33 percent) of the receiving water width. The rational is to avoid an impassable barrier to the migratory routes of aquatic species during the disposal operation. If data are lacking to calculate the specific areal extent of the permissible mixing zone, we will use the 10 percent average for bays and estuaries, and the 33 percent average for streams and rivers as a guideline. However, these values may be modified to minimize detrimental impacts on aquatic life (such as, reducing the permissible mixing zone if the disposal operation coincides with and is in proximity to the spawning of recreationally or commercially important species).

As in the case of sites designated for continual use, if the calculated dilution zone of the discharge material is equal to or less than the permissible mixing zone of the proposed, new disposal site, then the

potential impacts of contaminant releases would be considered minimal. Otherwise, further tests via bioassays (suspended-particulate phase bioassays) would be required to determine the potential impacts in the water column.

2. <u>The Proposed Disposal Site is a Low Energy Area.</u> A low energy area is a quiescent area that has only little movement or transport of the bottom sediments. It is an area where one would expect mounding of the disposal material with limited dispersion away from the site due to currents, tides, winds, etc. The resident time of the disposal material would be long enough to be concerned with the impacts on the bottom community if the quality of the disposal material were substantively worse than the quality of the disposal site sediments.

In order to determine chemical differences between the discharge material and the disposal site sediments, elutriate analyses will be required for both types of material and the results analyzed statistically. If the contaminants in the discharge material elutriate are not statistically higher at the 90 percent probability level than in the disposal site sediments, then we will conclude that the discharge material will not lead to any substantive increase in uptake of contaminants by the benthic community at the disposal site. On the other hand, if any contaminant in the discharge material elutriate is statistically higher than in the disposal site sediments, we will assume that there is a potential for substantive uptake of contaminants associated with the discharge material by the benthic organisms at the disposal site. Consequently, solid-phase bioassays would be required.

B. EVALUATION OF THE AQUATIC BIOASSAY RESULTS

The primary objective of the aquatic bioassay is to determine if there is a statistically significant increase in mean mortaility of the test organisms in the discharge material treatment(s) relative to the control. It is important to realize that a significant difference in a bioassay does not necessarily imply that an ecologically important impact would occur in the field. This must be kept in mind when interpreting results, particularly in cases where a difference of small magnitude between mortality in the control and test discharge material is shown to be statistically significant. Of course, regardless of the magnitude of the difference between mean mortality levels, if the means are not shown to be statistically different, they must be regarded as equal.

1. Suspended-particulate Phase Bioassays. The bioassay results will be interpreted in light of the dilution expected at the disposal site. The Corps will calculate the dilution zone. Once the dilution zone has been determined, it will be considered with the bioassay results to determine if the "limiting permissible concentration" (LPC; i.e. the concentration of discharge material that will not cause unreasonably acute or chronic toxicity or sublethal adverse effects including bioaccumulation of toxic materials in the human food chain) will or will not be exceeded. The likelihood of adverse effects is evaluated by graphically comparing a time-concentration mortality curve of the bioassay data with a time-concentration relationship for dilution of the discharge material. For details on how the comparison is made, the Ocean Implementation Manual should be consulted.

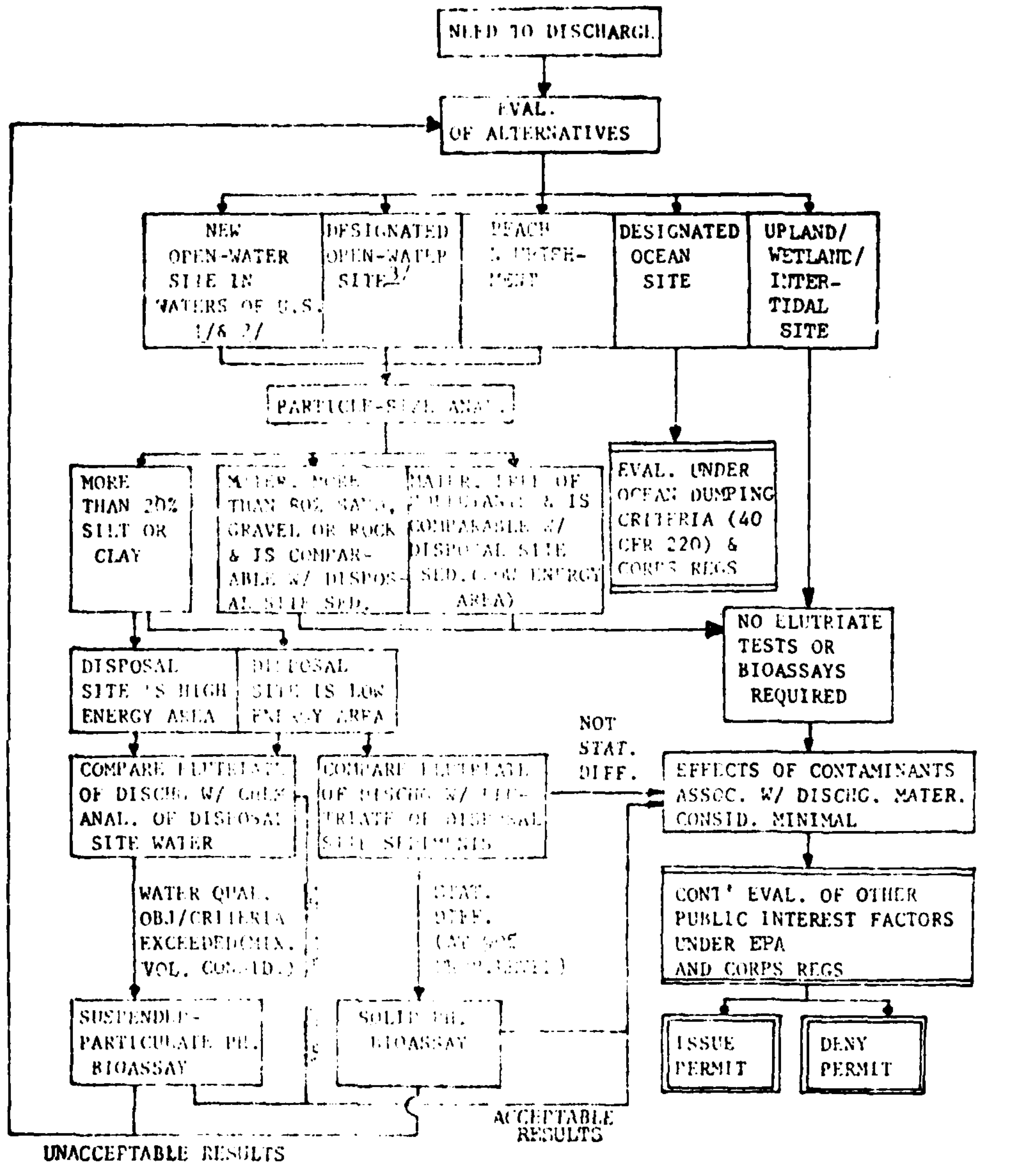
2. <u>Solid Phase Bioassays.</u> Unlike the suspended-particulate phase bioassay, there are no objective methods for considering dilution and mixing in the interpretation of solid phase bioassay data. Accordingly, we will follow the Ocean Implementation Manual and take the environmentally conservative approach that the LPC of the solid phase is operationally defined by the solid phase bioassay results. If the difference in mean mortality between animals in the control and test discharge material is statistically significant, the LPC will be considered exceeded, and the bioassay will be interpreted to mean that the material will have a real potential for causing environmentally unacceptable impacts on benthic organisms.

IV. SUMMARY

The type of information to be submitted with the application for Section 404 discharges is summarized in Table 1. Submission of analytical test data would depend on whether the proposed discharge material can be properly classified into one of the exclusions to testing. If the material cannot meet any of the exclusions, then the type of analytical tests required would depend on the selected open-water disposal site. Figure 2 summarizes when elutriate tests are to be conducted, and Figures 3 and 4 summarize when aquatic bioassays are necessary. An application for a Section 404 discharge will be regarded incomplete until all the necessary data are submitted to and evaluated by the Corps. This evaluation will be made prior to issuing the public notice (PN) on the subject discharge, and will be summarized in the PN.

These procedures are a supplement to EPA's 1975 guidelines for evaluating Section 404 discharges. Essentially, the 1975 guidelines provide a general assessment process for all types of Section 404 discharges; whereas these supplemental procedures detail the San Francisco District's approach in evaluating the potential contaminant impacts resulting from open-water discharges of dredged or fill material (see Figure 5). To cover all public interest factors that may be relevant to a given open-water discharge, the EPA's 1975 guidelines (40 CFR 230), these procedures, and the Corps' regulations (33 CFR 320 et seq.) will be used concurrently.

**PROCEDURE FOR EVALUATING
DISCHARGES OF DREDGED OR FILL MATERIAL**



1/ Use of new open-water disposal sites in San Francisco Bay will be limited to a 30+ foot depth (MLLW).

2/ Disposal at a new open-water site in San Francisco Bay will be limited to 30,000 cubic yards per activity and 50,000 cubic yards per year on a cumulative basis.

3/ For discharges not to exceed 10,000 cubic yards per activity to be disposed of at a historical open-water site designated for continual use, analytical tests may be modified on a case-by-case basis.

FIGURE 5

TECHNICAL EVALUATION OF BIOACCUMULATION

POTENTIAL OF PROPOSED DREDGING OPERATION FROM THE

RICHMOND LONG WHARF PORTION OF THE

JOHN F. BALDWIN SHIP CHANNEL

Final Report

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13 August 1982

ABSTRACT

The San Francisco District, Corps of Engineers, in accordance with Section 404 Evaluation Guidelines, has required bioaccumulation studies as part of the evaluation of proposed dredging of the John F. Baldwin Ship Channel, near Richmond, California. Bioaccumulation potential was assessed by Marine Bioassay Laboratories of Watsonville, California using modified laboratory and data interpretive techniques.

The test species was specified by the San Francisco District Army Corps of Engineers to be Tapes japonica (Japanese littleneck clam). Samples of dredge material were collected by Army Corps personnel and delivered to MBL's Davenport Facility for testing. Statistical analysis of bioaccumulation results revealed no significant uptake of: Cadmium, Copper, Lead, Mercury, Zinc, Total Chlorinated Hydrocarbons plus Polychlorobiphenyls (PCB's) or Petroleum Hydrocarbons.

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Section I. INTRODUCTION

A. Background

Dredging activites for Phase II of the John F. Baldwin Ship Channel may cause increased suspended solids loads in the water column. The California Regional Water Quality Control Board has expressed concern that sediments from the Richmond Long Wharf portion of the project may impact upon public clam-fishing grounds in the nearby Albany/Richmond areas and that the clams may bioconcentrate metals and/or organic compounds. In response to this concern, the San Francisco District, Army Corps of Engineers, has requested an assessment of the potential for bioaccumulation by clams of metals and organics from samples of materials to be dredged from the Baldwin Ship Channel (Contract DACW07-08-C-0002 81 Jun 01, Work Order #0005).

B. Study Objective and Scope

The study objective was to perform bioaccumulation testing on dredge materials.

The study scope is limited to implementation of specified testing methodology for determination of bioaccumulation potential.

C. Experimental Design

The objective of the study is to determine whether resuspended sediments from dredging activities in the Baldwin Ship Channel will contribute to bioaccumulation of any of several constituents by clams in public fishing grounds in the nearby Albany/Richmond Area. The experi-

ment was designed to simulate, the appropriate controls, the projected field situation. The experimental components are defined as follows:

(1) Control Sediment - Relatively unpolluted natural sediment collected from an offshore site near Moss Landing (Monterey, California).[1]

(2) Reference Sediment - Sediment collected by MBL personnel from the public clamming grounds in Albany/Richmond Area (Figure 1).

(3) Dredge Material - Sediment collected by San Francisco Army Corps of Engineers personnel from the Richmond Long Wharf portion of the John F. Baldwin Ship Channel.

(4) Experimental Animals - Japanese littleneck clams (Tapes japonica) collected from Washington State and purchased by MBL personnel from a local seafood distributor.

(5) Davenport Water - Seawater pumped through a 12-inch PVC intake line from 180 meters seaward of the beach at Davenport Landing, California.

In the Experimental Treatment, clams were acclimated for 10 days in Reference Sediment, placed in the bioaccumulation tanks in a tray with Reference Sediment, and exposed to a suspension of Dredge Material. The Reference Treatment represented a control for the suspension of dredge material and consisted of clams acclimated for 10 days to Reference Sediment, placed in the bioaccumulation tanks in a tray with Reference Sediment and exposed to suspended Reference Sediment. The Control Treatment consisted of clams placed in the bioaccumulation tanks in a tray with Control Sediment and exposed only to ambient seawater.

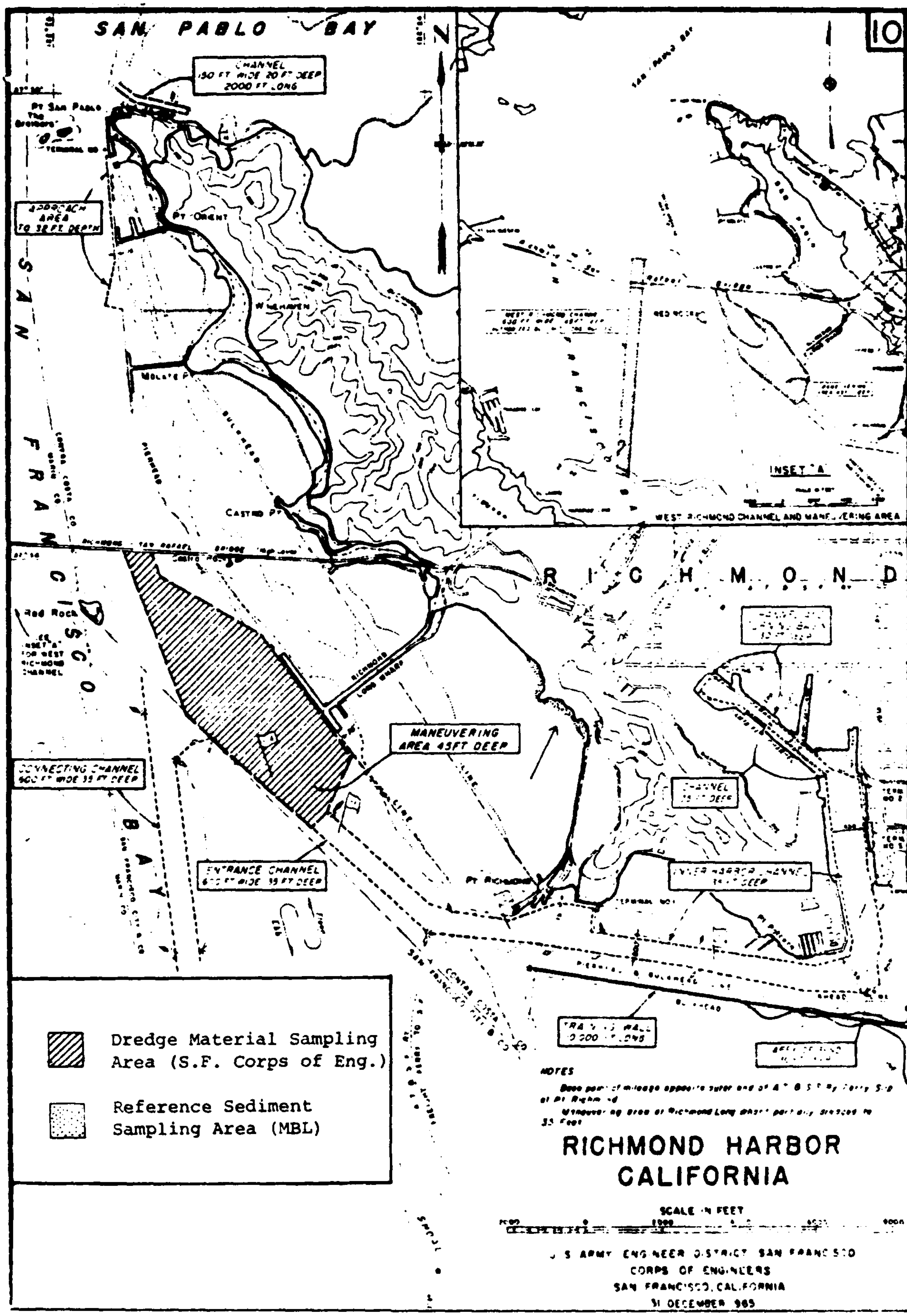

Figure 1. Sample Locations of Dredge Material and Reference Sediment used in Bioaccumulation Experiment.

Section II. MATERIALS AND METHODS

A. Experimental Animals

The species specified by the San Francisco District Army Corps of Engineers to be used in the bioaccumulation assessment was *Tapes japonica* the Japanese littleneck clam. Experimental animals were purchased from Joe Pucci & Sons, a commercial seafood wholesaler in Oakland, California.

B. Experimental Setup

The relatively long duration of the experiment requires that several conditions be facilitated by the physical setup. These include relatively constant temperature, continuous flow of seawater, aeration and mild sediment suspension. The setup developed for this test, by its simplicity, ensured that these conditions would be maintained.

A single "V" bottomed fiberglass tank measuring 4' x 8' x 5' high was internally partitioned into 4 equal segments. Each 2' x 4' x 5' deep segment was provided with a PVC aeration wand extending to and along the bottom of the "V", a constant inflow of seawater, and a series of baffles leading to an overflow drain (Figure 2). The control tank segment contained only Davenport Seawater. In each of the other tank segments, ten gallons of sediment were placed in the bottom before Davenport Seawater was introduced into the tank. Gentle aeration was provided which ensured both a constant high level of dissolved oxygen and maintenance of a mild sediment suspension throughout the water column. Excessive loss of suspended sediment via the overflow drain was avoided by routing the outgoing water through

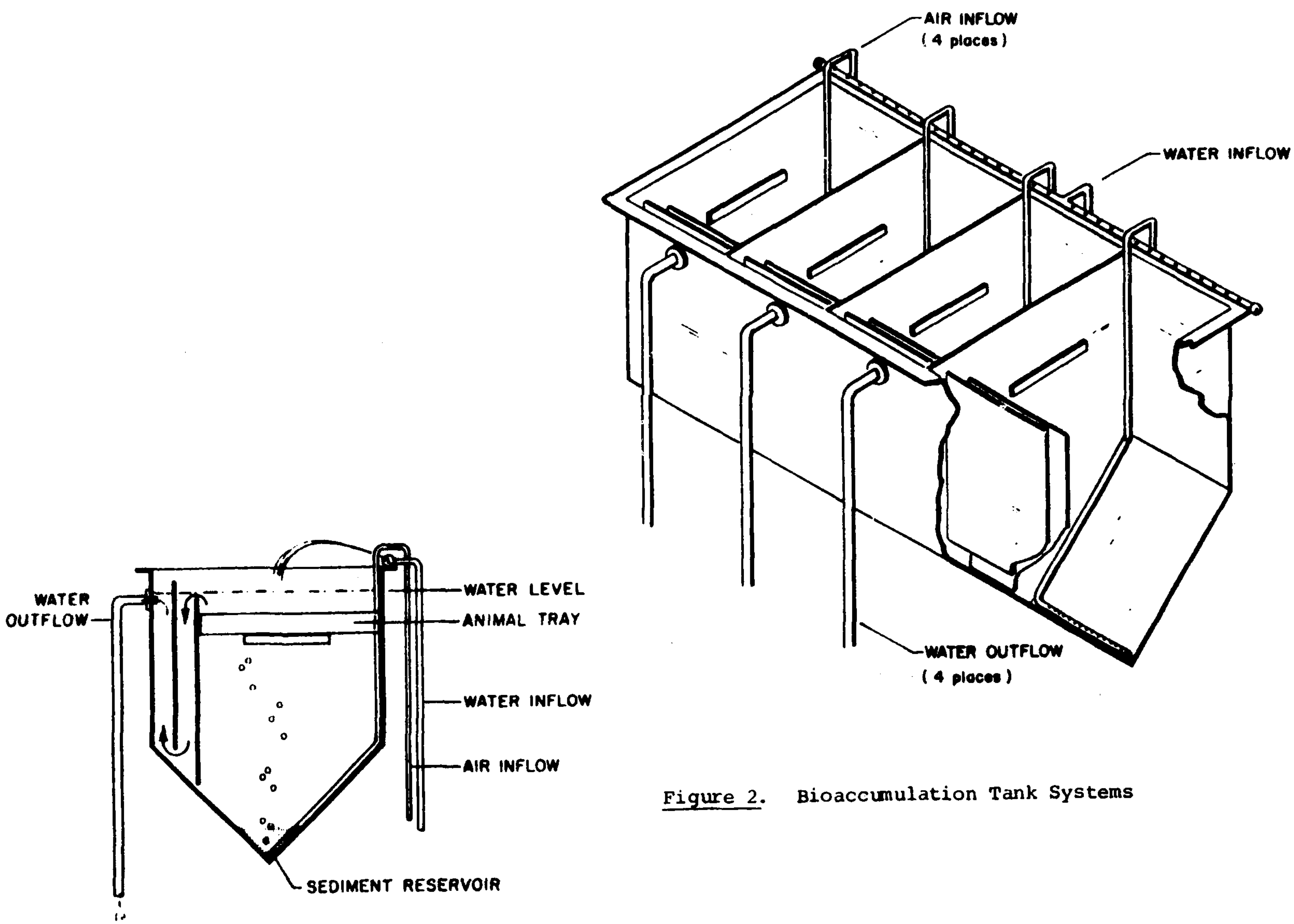

Figure 2. Bioaccumulation Tank Systems

the baffle system (Figure 2), wherein the slow net water flow and quiet water conditions facilitated settlement of suspended sediment and its return to the bottom sediment reservoir. Ambient seawater temperature at Davenport remained at 15 °C ± 2°C throughout the experiment. Flow into each experimental tank segment was maintained at about 1 liter per minute; providing a water turnover rate of about 2.5 tank volumes each 24 hours.

Experimental animals were placed in trays filled with "Reference" or "Control" sediment, and trays were held at a depth of 10" (25 cm) below the water surface in each experimental subunit (Figure 1).

No effort was made to feed the clams during the 10-day uptake phase nor the 10-day depuration phase of the experiment on the assumption that indigeneous phytoplankton passing through the sand filter would provide adequate nutrition. Survival of experimental animals was greater than 98% over the course of the experiment.

C. Experimental Procedures

Ten gallons of dredge material were placed in the bottom of the "Experimental" tank segment and 135 similarly-sized (7 to 9 cm) and acclimated *Tapes japonica* were placed in a tray containing Reference sediment. Ten gallons of Reference sediment were placed in the bottom of the "Reference" tank segment and 45 clams added to a Reference-sediment-filled tray. A third tank segment contained no sediment in the bottom, and 45 clams were placed in a tray filled with "Control" sediment. Water flow was initiated and aeration adjusted to produce a mild sediment suspension in Experimental and Reference tank segments.

Fifteen clams were removed from the Experimental tank after 0, 30, 60, 120 and 240 hours of exposure to suspended sediment. Upon completion of the

240-hour (10-day) uptake phase of the experiment, the remaining clams were transferred to a tray containing control sediment and placed into a tank segment containing no sediment in the bottom. Additional 15-clam samples were taken after 30, 60, 120 and 240 hours of exposure to clean water.

Since Reference and Control situations were designed as checks on possible bioaccumulation resulting from non-treatment variables in the experimental situation, tissue samples were collected only initially, after 240 hours of uptake and again after 240 hours of depuration.

After the 240-hour (10-day) uptake period, Reference clams were transferred to a tray filled with Control sediment-clean water situation for the remaining 10-days (depuration phase) of the experiment.

Each 15-clam sample was randomly divided into 3 groups of 5 clams each. After opening and rinsing, muscle tissue from foot, adductors and siphons was dissected. Muscle from each 5-clam subsample was composited and homogenized to provide tissue for analyzing copper, cadmium, zinc, lead, mercury, total chlorinated hydrocarbons plus polychlorobiphenyls (PCB's) and petroleum hydrocarbons. Each 15-clam sample, provided tissue enough for three replicate analyses of the above constituents.

Metal analyses were performed by Atomic Absorption Spectophotometry using an IL151 and IL555 graphite furnace. Total chlorinated hydrocarbons plus PCB's and petroleum hydrocarbon analyses were done by gas chromatography using a Hewlett Packard gas chromatograph, Model 5730.

D. Data Analysis and Interpretation

Data analysis and interpretive procedures are illustrated in Figure 3. To determine accumulation in tissue from exposure to dredge material, the data from the uptake phase of the Experimental, Reference and Control samples were subjected to homogeneity tests, multisample analyses (Analysis of Variance or Kruskal-Wallis) and multiple comparison (Dunnett's or Wilcoxon-Wilcox) using 0 hours as comparative datum. Significance was determined at alpha = 0.05. When accumulation, of a given constituent, did not occur, the biomagnification potential of the proposed operation was considered unlikely. When accumulation does occur, biomagnification potential must be more carefully examined.

Biomagnification potential, when significant uptake occurred, was evaluated by comparing the uptake rate constant (K_1) to the depuration rate constant (K_2). These constants are calculated by regression analysis [2] and a modification of the ASTM bioconcentration method [3] for toxic organic compounds.

The uptake rate constant is calculated as follows:

$$K_1 = \frac{\Sigma\, dCa/dt + K_2 Ca}{n_t}$$

where: dCa/dt = tangent to regression line at given time (t)

K_2 = slope of the regression line best fit to depuration

Ca = tissue concentration

n_t = number of sampling times

When the uptake rate constant is greater than the depuration rate constant, clearly a potential for biomagnification of that contaminant is greater than for a contaminant with more similar uptake and depuration rate constants

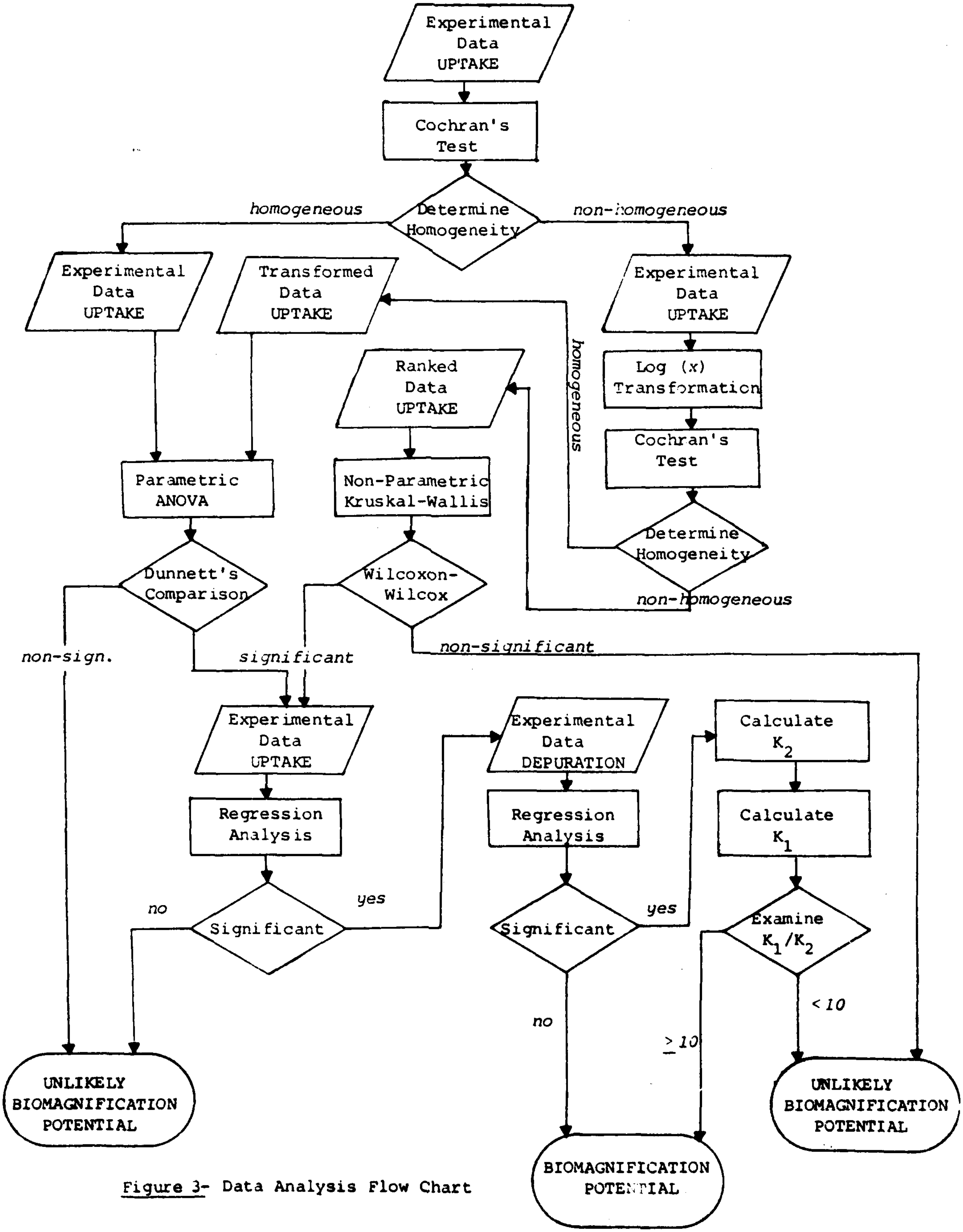

Figure 3- Data Analysis Flow Chart

Section III. RESULTS AND DISCUSSION

Muscle tissue of Tapes japonica was subjected to 240 hours exposure (10-days) to dredge material from the Richmond Long Wharf portion of the John F. Baldwin Ship Channel and was chemically analyzed for cadmium, copper, lead, mercury, zinc, total chlorinated hydrocarbons plus polychlorobiphenyls (PCB's) and petroleum hydrocarbons. These results are briefly summarized in Table 1 which lists sample means and variances.

All of the data were subjected to Cochran's test for homogeneity in preparation for statistical treatment. All data were homogeneous (Table 2). The data were then subjected to Analysis of Variance and Dunnett's test (Appendix Tables A-8 to A-13), both parametric tests. The Dunnett's test compared each of the sample means to the time zero reference treatment. The results of the Dunnett's test were not significant for any of the constituents. This analysis indicates that Tapes japonica muscle tissues did not accumulate any of the constituents tested for during the 240-hour exposure. Since uptake of these constituents did not occur, regression analyses to determine uptake and depuration rate constants (K_1 and K_2) were not necessary (Figure 3). It is concluded that biomagnification potential of the tested constituents: cadmium, copper, lead, mercury, zinc, total chlorinated hydrocarbons plus PCB's and petroleum hydrocarbons is unlikely to result from the dredging activities of the Richmond Long Wharf portion of Phase II of the John F. Baldwin Ship Channel.

TABLE 1. TISSUE CHEMISTRY SUMMARY ON TAPES JAPONICA MUSCLE TISSUE

CONSTITUENT		Tissue Concentration (n=3)						
		Sample Time (hours)						
		0	30	60	120	240	240 Ref	240 Con
Cadmium	$\bar{x}$	0.330	0.357	0.250	0.350	0.310	0.410	0.367
	s^2	0.0007	0.0014	0.0001	0.0012	0.0004	0.0039	0.0005
Copper	$\bar{x}$	0.843	0.993	0.683	0.810	0.943	0.767	0.673
	s^2	0.0025	0.0401	0.0081	0.0097	0.0024	0.0169	0.0049
Lead	$\bar{x}$	5.57	3.43	3.50	4.23	3.80	3.80	3.80
	s^2	3.57	0.69	0.07	0.08	0.07	0.13	0.0
Mercury	$\bar{x}$	0.273	0.303	0.273	0.300	0.283	0.313	0.277
	s^2	0.0002	0.0004	0.0002	0.0021	0.0006	0.0006	0.00003
Zinc	$\bar{x}$	6.17	5.30	6.67	6.10	6.50	7.03	6.07
	s^2	0.50	0.04	2.12	0.13	0.43	0.56	0.26
Total Chlorinated Hydrocarbons + PCB's	$\bar{x}$ s^2	None Detected in any sample (<0.01 mg/kg)						
Petroleum Hydrocarbons	$\bar{x}$ s^2	None Detected in any sample (<0.01 mg/kg)						

TABLE 2. SUMMARY OF STATISTICAL ANALYSES

CONSTITUENT	Cochran's Test (C-value)	Analysis of Variance (F-value)	Significant Accumulation (Dunnett's)
Cadmium	0.4756 ns	6.39*	none
Copper	0.4740 ns	3.63*	none
Lead	0.7744 ns	2.42 ns	none
Mercury	0.5085 ns	1.30 ns	none
Zinc	0.5248 ns	1.57 ns	none
Total Chlorinated Hydrocarbons & PCB's	-	-	none
Petroleum Hydrocarbons	-	-	none

ns indicates non-significant result (alpha = 0.05)
* indicates significant result (alpha = 0.05)

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APPENDIX

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TABLE A-1 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry - Cadmium

Treatment	Cadmium Tissue Concentration (mg/kg)						
	Elapsed Time (hours) 0	30	60	120	240	Reference 240	Control 240
UPTAKE PHASE	0.31	0.33	0.26	0.33	0.31	0.39	0.34
	0.32	0.40	0.24	0.39	0.33	0.48	0.38
	0.36	0.34	0.25	0.33	0.29	0.36	0.38
$\bar{x}$	0.330	0.357	0.250	0.350	0.310	0.410	0.367
s^2	0.0007	0.0014	0.0001	0.0012	0.0004	0.0039	0.0005
DEPURATION PHASE	0.31	0.35	0.37	0.37	0.35	0.37	0.36
	0.33	0.36	0.44	0.36	0.39	0.43	0.41
	0.29	0.35	0.36	0.33	0.36	0.46	0.46
$\bar{x}$	0.310	0.353	0.390	0.353	0.367	0.420	0.410
s^2	0.0004	0.00003	0.0019	0.0004	0.0004	0.0021	0.0025

TABLE A-2 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry - Copper

Treatment	Tissue Concentration (mg/kg)						
	Elapsed Time (hours) 0	30	60	120	240	Reference 240	Control 240
UPTAKE PHASE	0.85	0.80	0.77	0.73	0.92	0.68	0.74
	0.89	0.98	0.69	0.92	1.00	0.92	0.68
	0.79	1.20	0.59	0.78	0.91	0.70	0.60
$\bar{x}$	0.843	0.993	0.683	0.810	0.943	0.767	0.673
s^2	0.0025	0.0401	0.0081	0.0097	0.0024	0.0169	0.0049
DEPURATION PHASE	0.92	0.86	0.63	0.63	0.71	0.66	0.74
	1.00	0.71	0.77	0.63	0.70	0.95	0.74
	0.91	0.75	0.60	0.63	0.64	1.00	0.64
$\bar{x}$	0.943	0.773	0.667	0.630	0.683	0.870	0.707
s^2	0.0024	0.0060	0.0082	0.0	0.0014	0.0337	0.0033

TABLE A-3 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry - Lead

Treatment	Lead Tissue Concentration (mg/kg)						
	Elapsed Time (hours) 0	30	60	120	240	Reference 240	Control 240
UPTAKE PHASE	7.7	2.5	3.6	3.9	3.6	3.4	3.8
	4.9	4.1	3.7	4.4	4.1	4.1	3.8
	4.1	3.7	3.2	4.4	3.7	3.9	3.8
$\bar{x}$	5.57	3.43	3.50	4.23	3.80	3.80	3.80
s^2	3.57	0.69	0.07	0.08	0.07	0.13	0.0
DEPURATION PHASE	3.6	2.8	4.2	3.8	3.5	3.4	3.1
	4.1	3.6	4.7	3.9	3.3	4.0	3.9
	3.7	3.7	4.5	3.4	2.9	3.8	3.3
$\bar{x}$	3.80	3.37	4.47	3.70	3.17	3.73	3.43
s^2	0.07	0.24	0.06	0.07	0.17	0.09	0.17

TABLE A-4 BALDWIN SHIP CAHNNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry - Mercury

Treatment		Mercury Tissue Concentration (mg/kg)						
		Elapsed Time (hours) 0	30	60	120	240	Reference 240	Control 240
UPTAKE PHASE		0.26	0.32	0.29	0.31	0.31	0.29	0.28
		0.27	0.28	0.27	0.25	0.26	0.31	0.27
		0.29	0.31	0.26	0.34	0.28	0.34	0.28
	$\bar{x}$	0.273	0.303	0.273	0.300	0.283	0.313	0.277
	s^2	0.0002	0.0004	0.0002	0.0021	0.0006	0.0006	0.00003
DEPURATION PHASE		0.31	0.31	0.32	0.24	0.26	0.32	0.27
		0.26	0.26	0.28	0.27	0.27	0.34	0.29
		0.28	0.37	0.24	0.26	0.28	0.26	0.31
	$\bar{x}$	0.283	0.313	0.280	0.257	0.270	0.307	0.290
	s^2	0.0006	0.0030	0.0016	0.0002	0.0001	0.0017	0.0004

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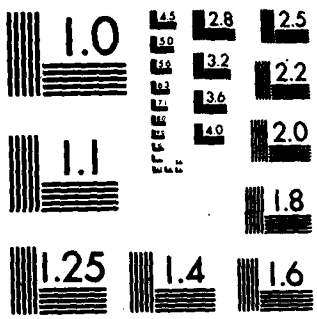

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TABLE A-5 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry - Zinc

Treatment		Zinc Tissue Concentration (mg/kg)						
		Elapsed Time (hours)					Reference	Control
		0	30	60	120	240	240	240
UPTAKE PHASE		5.4	5.3	6.5	5.8	5.9	7.0	5.5
		6.8	5.1	8.2	6.5	7.2	7.8	6.2
		6.3	5.5	5.3	6.0	6.4	6.3	6.5
	$\bar{x}$	6.17	5.30	6.67	6.10	6.50	7.03	6.07
	s^2	0.50	0.04	2.12	0.13	0.43	0.56	0.26
DEPURATION PHASE		5.9	5.9	6.5	6.4	6.2	6.4	6.6
		7.2	6.9	7.8	6.6	6.9	7.3	6.1
		6.4	6.4	6.1	5.3	6.6	7.3	7.0
	$\bar{x}$	6.50	6.40	6.80	6.10	6.57	7.00	6.57
	s^2	0.43	0.25	0.79	0.49	0.12	0.52	0.20

TABLE A-6 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry TICH & PCB's

Treatment	TICH Tissue Concentration (mg/kg)						
	Elapsed Time (hours)					Reference	Control
	0	30	60	120	240	240	240
UPTAKE PHASE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
$\bar{x}$							
s^2							
DEPURATION PHASE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	< 0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
$\bar{x}$							
s^2							

TABLE A-7 BALDWIN SHIP CHANNEL BIOACCUMULATION

Tapes japonica

Tissue Chemistry PHC's

Treatment	PHC's Tissue Concentration (mg/kg)						
	Elapsed Time (hours) 0	30	60	120	240	Reference 240	Control 240
UPTAKE PHASE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
$\bar{x}$							
s^2							
DEPURATION PHASE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
$\bar{x}$							
s^2							

TABLE A-8 BALDWIN SHIP CHANNEL BIOACCUMULATION

Analysis of Variance - Uptake Phase

Tissue Chemistry - Tapes japonica

Dredge Material Stations	Analysis of Variance				
	Source	Degrees of Freedom	Sum of Squares	Mean Square	F-Value
Cadmium (mg/kg)	Total	20	0.062		
	Groups	6	0.045	0.0075	6.39*
	Error	14	0.016	0.0012	
	Critical Value = 2.85				
Copper (mg/kg)	Total	20	0.438		
	Groups	6	0.266	0.0444	3.63*
	Error	14	0.171	0.0122	
	Critical Value = 2.85				
Lead (mg/kg)	Total	20	18.832		
	Groups	6	9.592	1.599	2.42
	Error	14	9.240	0.660	
	Critical Value = 2.85				
Mercury (mg/kg)	Total	20	0.013		
	Groups	6	0.005	0.0008	1.30
	Error	14	0.009	0.0006	
	Critical Value = 2.85				
Zinc (mg/kg)	Total	20	13.550		
	Groups	6	5.443	0.9071	1.57
	Error	14	8.107	0.5790	
	Critical Value = 2.85				
Total Identifiable Chlorinated Hydrocarbons & Polychlorobiphenyls (PCB's)			None detected	(< 0.01 mg/kg)	
Petroleum Hydrocarbons			None detected	(< 0.1 mg/kg)	

* indicates significant result
alpha = 0.05

TABLE A-9 BIOACCUMULATION PHASE - Tapes japonica

Multiple Comparisons

Uptake Phase - Cadmium

Range From Comparative Datum (k)	Critical Value (q')	DUNNETT'S TEST Difference of Means *parametric*	WILCOXON-WILCOX Difference of Rank Sums *non-parametric*	Computed Value (q)
3	2.08	$\bar{x}_{30} - \bar{x}_0 = 0.027$		0.95
3	2.08	$\bar{x}_{60} - \bar{x}_0 = 0.080$		-2.83
2	1.76	$\bar{x}_{120} - \bar{x}_0 = 0.020$		0.71
2	1.76	$\bar{x}_{240} - \bar{x}_0 = 0.020$		-0.71
5	2.37	$\bar{x}_R - \bar{x}_0 = 0.080$		2.83*
4	2.25	$\bar{x}_c - \bar{x}_0 = 0.037$		1.31

TABLE A-10 BIOACCUMULATION PHASE - Tapes japonica

Multiple Comparisons

Uptake Phase - Copper

Range From Comparative Datum (k)	Critical Value (q')	DUNNETT'S TEST Difference of Means *parametric*	WILCOXON-WILCOX Difference of Rank Sums *non-parametric*	Computed Value (q)
3	2.08	$\bar{x}_{30} - \bar{x}_0 = 0.150$		1.66
4	2.25	$\bar{x}_{60} - \bar{x}_0 = 0.160$		-1.77
2	1.76	$\bar{x}_{120} - \bar{x}_0 = 0.033$		-0.37
2	1.76	$\bar{x}_{240} - \bar{x}_0 = 0.100$		1.11
3	2.08	$\bar{x}_R - \bar{x}_0 = 0.076$		-0.84
5	2.37	$\bar{x}_c - \bar{x}_0 = 0.170$		-1.88

t = transformed data used in calculations
\- = not determined
* = significant result (alpha = 0.05)
r = Reference
c = Control

TABLE A-11 BIOACCUMULATION PHASE - Tapes japonica

Multiple Comparisons

Uptake Phase - Lead

Range From Comparative Datum (k)	Critical Value (q')	DUNNETT'S TEST Difference of Means *parametric*	WILCOXON-WILCOX Difference of Rank Sums *non-parametric*	Computed Value (q)
5	2.37	$\bar{x}_{30} - \bar{x}_0$ = -2.14		-3.33
4	2.25	$\bar{x}_{60} - \bar{x}_0$ = -2.07		-3.12
2	1.76	$\bar{x}_{120} - \bar{x}_0$ = -1.34		-2.02
3	2.08	$\bar{x}_{240} - \bar{x}_0$ = -1.77		-2.67
3	2.08	$\bar{x}_R - \bar{x}_0$ = -1.77		-2.67
3	2.08	$\bar{x}_c - \bar{x}_0$ = -1.77		-2.67

TABLE A-12 BIOACCUMULATION PHASE - Tapes japonica

Multiple Comparisons

Uptake Phase - Mercury

Range From Comparative Datum (k)	Critical Value (q')	DUNNETT'S TEST Difference of Means *parametric*	WILCOXON-WILCOX Difference of Rank Sums *non-parametric*	Computed Value (q)
5	2.37	$\bar{x}_{30} - \bar{x}_0$ = 0.030		1.50
0	-	$\bar{x}_{60} - \bar{x}_0$ = 0.0		-
4	2.25	$\bar{x}_{120} - \bar{x}_0$ = 0.027		1.35
3	2.08	$\bar{x}_{240} - \bar{x}_0$ = 0.010		0.50
6	2.46	$\bar{x}_R - \bar{x}_0$ = 0.040		2.00
2	1.76	$\bar{x}_c - \bar{x}_0$ = 0.004		0.20

t = transformed data used in calculations
- = not determined
* = significant result (alpha = 0.05)
r = Reference
c = Control

TABLE A-13 BIOACCUMULATION PHASE - *Tapes japonica*

Multiple Comparisons

Uptake Phase - Zinc

Range From Comparative Datum (k)	Critical Value (q')	DUNNETT'S TEST Difference of Means *parametric*	WILCOXON-WILCOX Difference of Rank Sums *non-parametric*	Computed Value (q)
4	2.25	$\bar{x}_{30} - \bar{x}_0 = -0.87$		-1.40
3	2.08	$\bar{x}_{60} - \bar{x}_0 = 0.50$		0.80
2	1.76	$\bar{x}_{120} - \bar{x}_0 = -0.07$		-0.11
2	1.76	$\bar{x}_{240} - \bar{x}_0 = 0.33$		0.53
4	2.25	$\bar{x}_R - \bar{x}_0 = 0.86$		1.38
3	2.08	$\bar{x}_c - \bar{x}_0 = -0.10$		-0.16

t = transformed data used in calculations
* = significant result (alpha = 0.05)
r = Reference
c = Control

APPENDIX C
FISH AND WILDLIFE SERVICE COORDINATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
U.S. Fish and Wildlife Service
2800 Cottage Way, Room E-2727
Sacramento, California 95825

November 17, 1982

District Engineer
San Francisco District, Corps of Engineers
211 Main Street
San Francisco, California 94105

Dear Sir:

This report supplements our detailed report of November 12, 1963, on the effects that deepening the San Francisco Bay to Stockton Navigation Project would have on fish and wildlife resources. Supplementation of the previous report is necessary because of modifications of the authorized construction plan that are now under consideration, and because of improved perceptions of project effects gained during the intervening time. This supplemental report, which deals only with Phase II of the John F. Baldwin segment of the San Francisco Bay to Stockton Navigation Project, was prepared under the authority, and in accordance with the provisions, of the Fish and Wildlife Cordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report is concurred in by the California Department of Fish and Game, as indicated in the attached copy of a letter from Director E.C. Fullerton, dated October 25, 1982. The report has been reviewed by the National Marine Fisheries Service.

Description of the Project

The San Francisco Bay to Stockton Navigation Project is comprised of two major segments: (1) the John F. Baldwin Ship Channel, extending from deep water in the Pacific Ocean to Pt. Edith near the community of Avon in lower Suisun Bay; and (2) the Stockton Ship Channel, extending from Pt. Edith to the City of Stockton. Deepening and widening of the existing navigation channel was authorized by the River and Harbor Act of 1965 (Public Law 89-298).

For planning and construction purposes, the John F. Baldwin Ship Channel is divided into three phases. Phase I applies to the deepening of the channel across San Francisco Bar in the Pacific Ocean to - 55 feet MLLW. Construction of Phase I work was completed in 1974. Phase II, the subject of this report, pertains to the excavation of West Richmond Channel (immediately south of Richmond-San Rafael Bridge) and the deepening of the Richmond Long Wharf Maneuvering Area to depths of 45 feet (Plate I). Under Phase III of John F. Baldwin Ship Channel construction, planning for which has been deferred pending resolution of technical problems, the channel would be deepened to 45 feet through Pinole Shoal in San Pablo Bay, upper Carquinez Strait, and lower Suisun Bay to Pt. Edith. Deepening of the Stockton Ship Channel (from Pt. Edith to Stockton) to -35 feet is in progress.

In lieu of West Richmond Channel construction, an element of the authorized plan for the San Francisco Bay to Stockton Navigation Project, the Corps of Engineers is evaluating the merits of deepening the Southampton Channel. The Southampton Channel is an existing navigation channel linking the Port of Richmond, as well as the Richmond Long Wharf Maneuvering Area, to deep water of San Francisco Bay. A further modification of the authorized plan under consideration by the Corps is disposal of dredged material in deep water near Alcatraz Island. Under the authorized plan, material dredged from West Richmond Channel and the Long Wharf area would be disposed of in shallow bay waters near Brooks Island.

Construction of the project according to the modified plan would involve clam shell or hopper dredge excavation of about 8.7 million cubic yards of material over a 3-year period, or a 6-year period if construction were curtailed during the winter months. Excavation would be to a depth of 47 feet to provide a 2-foot overdepth. The bottom width of the Southampton Channel would be 650 feet. Material dredged from The Southampton Channel and the Richmond Long Wharf Maneuvering Area would be disposed of in deep water 0.3 miles south of Alcatraz Island. Maintenance of the completed project would involve dredging about 100,000 cubic yards every 5 years with disposal south of Alcatraz.

Fish and Wildlife Resources

Fish

For anadromous fishes, the waters of the immediate project area, being generally deeper than 35 feet, function mainly as a segment of the migration corridor linking ocean and riverine habitats. All anadromous species associated with the rivers and streams of California's Central Valley must traverse the project area, or adjacent waters of Central San Francisco Bay, in their journeys to and from the sea. Among salmonid species, the chinook salmon and steelhead trout are the most important visitors to project area waters. Striped bass, American shad, and white sturgeon are other anadromous fishes for which project area waters afford a migration avenue. The shallow waters proximate to the shore and outside the area to be dredged are believed to provide rearing habitat for the young of some anadromous species. That this may be so is suggested by the results of otter trawl and beach seine sampling done by the Fish and Wildlife Service in 1974 in subtidal areas of San Pablo Bay near the City of Richmond (3). Young-of-the-year striped bass predominated among the various fishes captured in July, August, and September.

It is known that the intertidal zone and subtidal area (up to about 15 feet in depth) on the landward side of the Richmond Long Wharf are utilized by the Pacific herring for spawning (5). From December through March, gravid females cast their roe onto the substrate of these shallows and of other near-shore reaches of the Central Bay. The commercial fishery for herring that occurs in San Francisco Bay is directed more toward the harvest of roe than of the fish themselves, roe being prized as a gourmet food in Japan. Other piscine inhabitants of the near-shore zone, as well as the deeper water of the channel area, are northern anchovy, starry flounder, staghorn sculpin, shiner perch, surf smelt, jack smelt, threespine stickleback, northern midshipman, Japanese goby, ling cod, sablefish, Pacific hake,

cabezon, English sole, tiger shark, bat ray, spiny dogfish, Sacramento smelt, Pacific tomcod, white croaker, white surfpurch, brown rockfish, speckled sanddab, and California tonguefish.

Prominent among the benthic and bottom-dwelling invertebrates in and adjacent to the project area are amphipods, isopods, jellyfishes, horse mussel, basket cockle, Japanese cockle, soft-shelled clam, Franciscan bay shrimp, black-tailed bay shrimp, Oriental shrimp, hermit crab, slender crab, and Dungeness crab.

Most of the sport fishing that takes place in the vicinity of the project is for striped bass. An area favored by striper anglers is located off the north[illegible]st shore of Tiburon Peninsula, near the seaward end of the West Richmond Chan[illegible] (2).

Wildlife

Wildlife utilization of the waters of the project area is limited to th[illegible]ade by certain avian species and by a sea mammal, the harbor seal.

Although San Francisco Bay provides habitat that is of critical importance to the maintenance of many of the species of migratory birds that comprise the Pacific Flyway population, most bird use is associated with intertidal areas and water no deeper than about 18 feet. The relatively deep water of the project area is utilized primarily by piscivorous birds such as grebes, cormorants, pelicans, gulls and terns, and by waterfowl such as canvasback, redhead, goldeneye, bufflehead, scaups, and scoters that make use of the expanse of open water for resting.

For many years, Castro Rocks, near the eastern end of the Richmond-San Rafael Bridge, has been used as a hauling-out site by a small population of harbor seals (2).

Little, if any, hunting for waterfowl occurs in the project area.

Discussion

Although shifting bottom sediments and a roiled and turbid water column are recurrent natural conditions to which organisms inhabiting San Francisco Bay are adapted, it may reasonably be presumed that an intensification of these conditions due to dredging and spoiling operations has a negative impact on the well-being of aquatic life. However, the results of studies addressing this question have not generally demonstrated that the impacts of channel excavation and disposal of uncontaminated dredged material in deep water are significantly adverse. It appears on the basis of empirical and experimental evidence gathered thus far that the adverse impacts are of a transitory nature and that repopulation of disturbed areas occurs rapidly. For new channels, however, the original diversity of species may not be regained (1,7).

In 1981, San Francisco Bay Marine Research Center, Inc., conducted a suspended particulate phase bioassay and a bioaccumulation test using bottom material from the Long Wharf Maneuvering Area and bay water from the Alcatraz disposal site

(4). Bottom materials from West Richmond Channel and Southampton Channel were not tested inasmuch as core and grab sampling revealed these bottom areas to be hard-packed sand. Of the three organisms bioassayed (English sole, grass shrimp, and a copepod), only English sole experienced sufficient mortality over the 96-hour test period to permit computation of LC50 values. Based on their observations during the bioassay, the researchers speculated that, because of the sole's bottom-dwelling habit, those fish that died may have succumbed to suffocation as suspended particulates settled to the bottoms of the 10-gallon aquariums in which they were held, rather than to any biologically active contaminants associated with the bottom material tested. Suffocation of English sole due to spoil deposition at the deep-water Alcatraz site, where fish are not confined, is not likely to occur. In any event, when the dilution of dredged material calculated to occur during initial mixing with bay water at Alcatraz was taken into account, it was concluded that the fish would not be exposed to concentrations of dredged material great enough to cause significant mortality due to any biologically active constituents. In its bioaccumulation test, Marine Research Center used Japanese cockle to measure the uptake of mercury, copper, zinc, lead, cadmium, chlorinated hydrocarbons, petroleum hydrocarbons, and polychlorinated biphenyls from Long Wharf Maneuvering Area sediments. Bioaccumulation over a 24-day test period was demonstrated for lead and copper, but not to levels judged to be significant with respect to established criteria.

In the years since deepening of the John F. Baldwin Ship Channel was authorized, concern has arisen that channel deepening would promote the incursion of sea water into the estuary and thereby raise salinity levels in Suisun Bay and the waterways of the Sacramento-San Joaquin Delta. To develop information bearing on this question, the Corps of Engineers performed a series of hydraulic tests at its San Francisco Bay-Delta Model facility, Sausalito, California, and Waterways Experiment Station, Vicksburg, Mississippi (6). On the basis of these tests it is believed that construction of Phase II of the John F. Baldwin Ship Channel project, as authorized, would not alter salinity distribution in Suisun Bay and the Delta in any significant way. The results of the testing program do indicate, however, that construction of Phase III (i.e., deepening Pinole Shoal Channel through San Pablo Bay; deepening Carquinez Strait Channel; and deepening Suisun Bay Channel from Martinez to Pt. Edith) would significantly alter salinity distribution in Suisun Bay and the Delta. Although the effects of deepening Southampton Channel (in lieu of West Richmond Channel) were not studied, it does not appear that this modification of the authorized Phase II plan would influence salinity distribution in the upper estuary in a way that would differ from the West Richmond Channel. The model studies indicate that salinity distribution in Suisun Bay and the Delta would not be affected unless the Carquinez Strait Channel were deepened.

The adverse effects of project construction on fish and wildlife resources could be substantially reduced in two ways by implementing the modified plan rather than the authorized plan for Phase II. In the first instance, the modified plan obviates the need to excavate the West Richmond Channel which, because of its natural depths in excess of 35 feet MLLW, has never been dredged. The Southampton Channel, on the other hand, was excavated to a depth of 37 feet MLLW years ago and has since been periodically dredged to maintain that depth. Moreover, the Southampton Channel will in all liklihood be deepend as part of the Corps of

Engineers plan to improve navigation channels serving Richmond Harbor. The Department of the Army is expected to seek Congressional authorization to deepen Southampton Channel, Richmond Harbor Entrance Channel, and Richmond Harbor Channel at an early date. Thus, selection of the modified plan for Phase II would essentially reduce by half the area of bay bottom that would otherwise be disrupted by channel deepening in the general project area. A reduction would also be realized in the total volume of dredged material to be disposed of from the two projects.

In the second instance, the modified plan provides for disposal of dredged material in deep waters of the Bay at Alcatraz Island rather than in shallow Bay waters in the vicinity of Brooks Island near Richmond Harbor. The shallow waters near Brooks Island are biologically important in that they afford habitat for bottom-dwelling mollusks, annelids, and arthropods as well as small nektonic creatures, all of which contribute to the sustenance of higher forms of life such as fishes, marine birds, and waterfowl. The shallow water areas of the Bay are crucially important nursery grounds for the young of various fishes including starry flounder, shiner surfperch, top smelt, northern anchovy, herring, and striped bass. While the deep water at Alcatraz is by no means devoid of aquatic life, it is less important than the shallow water areas of the Bay on a relative ecological basis.

Disposal of dredged material at the Alcatraz site would offer an additional advantage over the authorized disposal plan if release of the material into the water column is done only on the ebb flow of the tide. Releasing dredged material during the outgoing tide would maximize the transport of sediment from the estuary to the sea.

Recommendations

To minimize the adverse effects of project construction on fish and wildlife resources, the Fish and Wildlife Service recommends that:

1. Construction be done in accordance with the modified plan, which provides for deepening of the Southampton Channel and disposal of dredged material in deep water near Alcatraz Island;

2. Deposition of dredged material at the Alcatraz disposal site be done only during the ebb flow of the tide.

Please advise us of your proposed actions concerning these recommendations.

Sincerely yours,

James D. Carson

for James J. McKevitt
Field Supervisor

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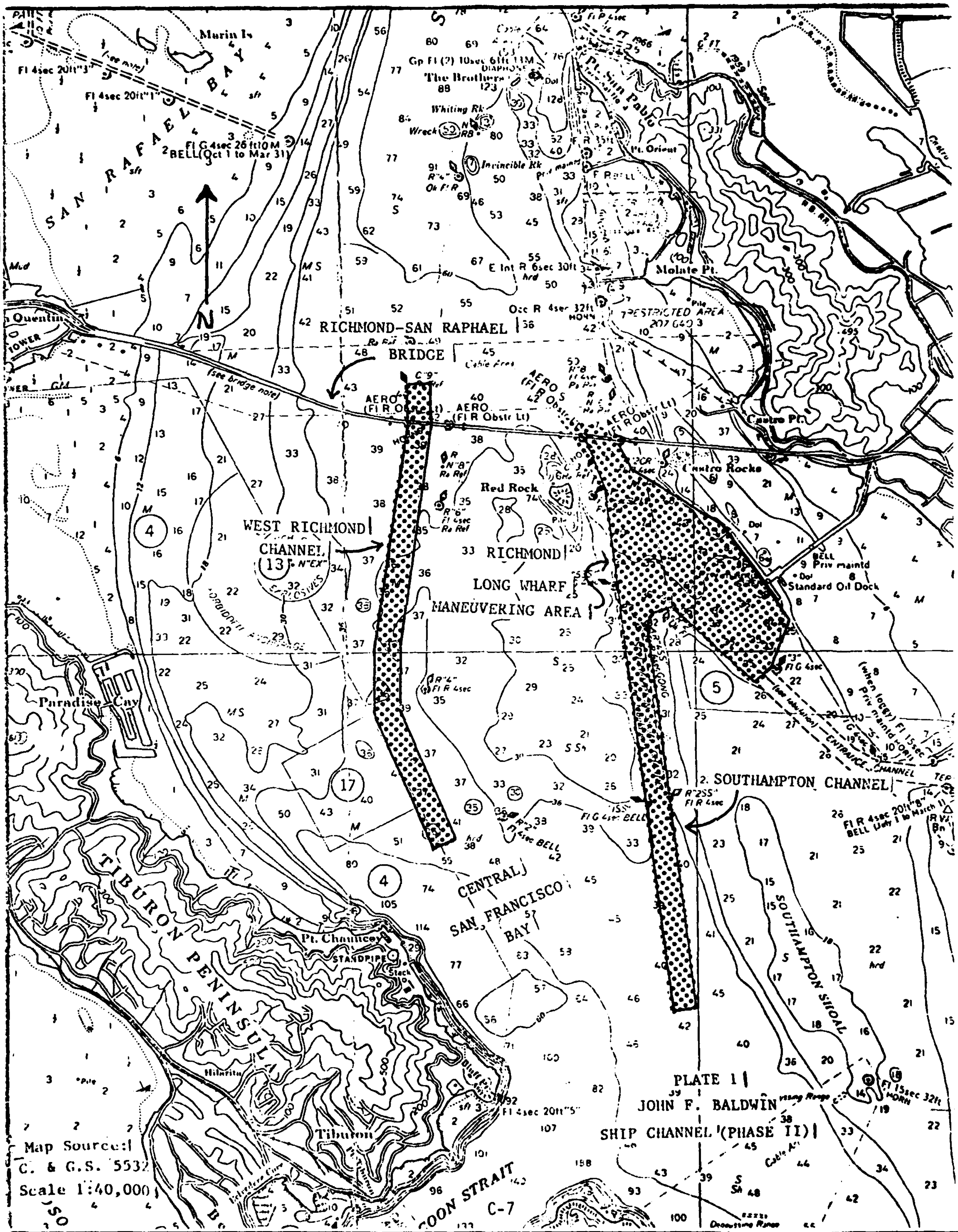
6. U.S. Army Corps of Engineers. 1980. Hydraulic model study for the John F. Baldwin Shp Channel incremental improvements with/without fixed submerged barriers. Prepared by Tetra Tech, Inc., Lafayette, California.

7. U.S. Fish and Wildlife Service. 1970. Effects on fish resources of dredging and spoil disposal in San Francisco and San Pablo Bays, California. Tiburon Marine Laboratory. Tiburon, California.



RICHMOND-SAN RAPHAEL
BRIDGE
WEST RICHMOND
CHANNEL
RICHMOND
LONG WHARF
MANEUVERING AREA
SOUTHAMPTON CHANNEL
CENTRAL
SAN FRANCISCO
BAY
SAN RAFAEL BAY
TIBURON PENINSULA
SOUTHAMPTON SHOAL
Red Rock
Castro Rocks
Standard Oil Dock
Molate Pt.
Pt. San Pablo
Pt. Chauncey
Paradise Cay
Tiburon
Marin Is
The Brothers
Whiting Rk
Invincible Rk
Pt. Orient
Castro Pt.
N
PLATE 1
JOHN F. BALDWIN
SHIP CHANNEL (PHASE II)
Map Source:
C. & G.S. 5532
Scale 1:40,000
COON STRAIT

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
(916) 445-3531

October 25, 1982

William D. Sweeney, Area Manager
U.S. Fish & Wildlife Service
2800 Cottage Way, Room E-1803
Sacramento, CA 95825

Dear Mr. Sweeney:

This letter is in response to your June 29, 1982 transmittal regarding your draft report to the Corps of Engineers on the effects that deepening the San Francisco Bay to Stockton Navigation Project (John F. Baldwin Ship Channel - Phase II) would have on fish and wildlife resources.

We have reviewed the report and concur in its findings.

Sincerely,

E C Fullerton

Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
AREA OFFICE
2800 Cottage Way, Room E-2740
Sacramento, California 95825

APR 0 2 1982

In reply refer to: SESO
#1-1-82-SP-194

Mr. Jay K. Soper
Management Division
Department of the Army
San Francisco District
Corps of Engineers
211 Main Street
San Francisco, California 94105

Subject: Request for List of Endangered and Threatened Species in the Area of the John F. Baldwin Ship Channel (SF Bay to Stockton), Contra Costa County, California

Dear Mr. Soper:

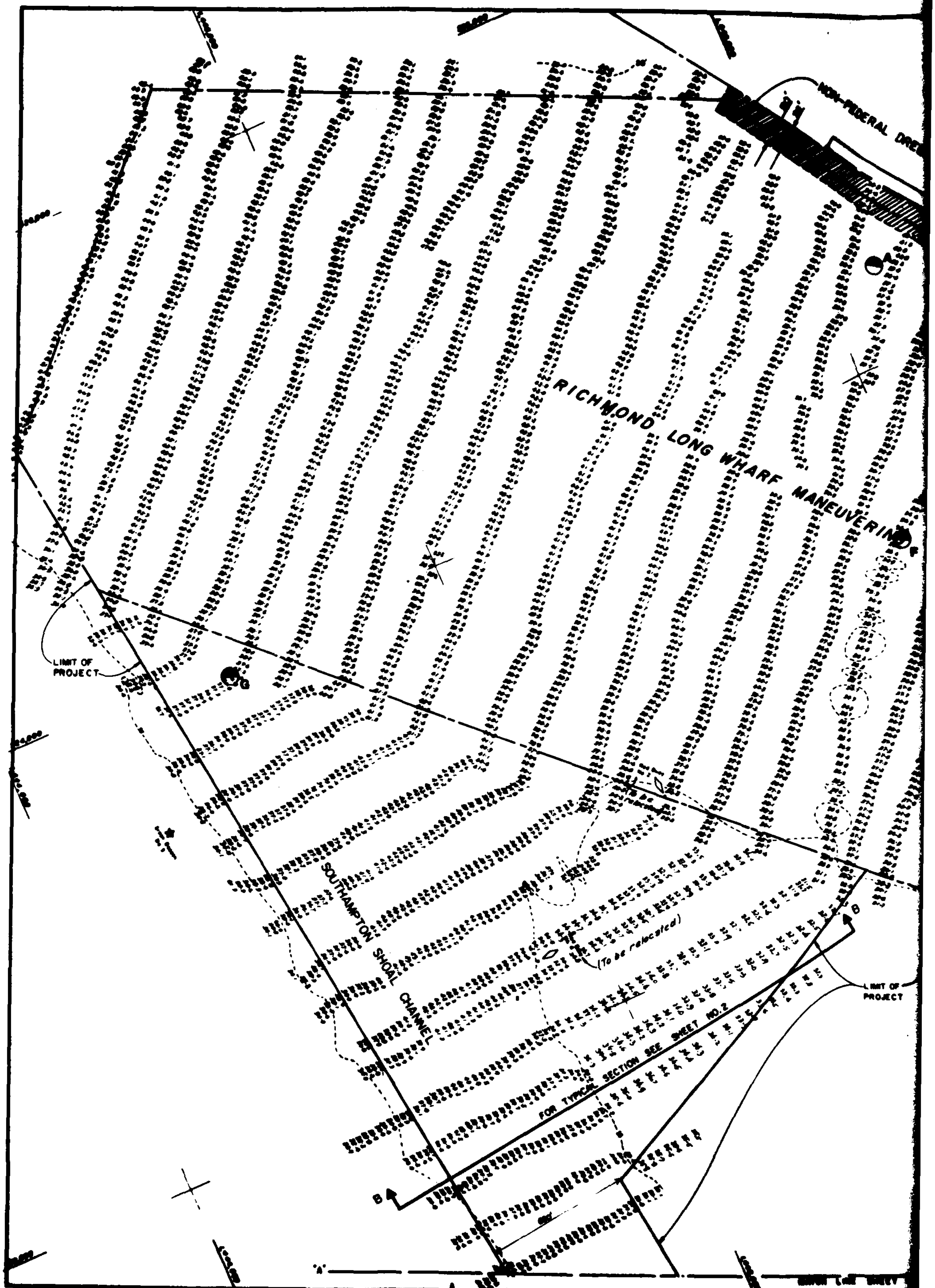
This is in reply to your letter of March 16, 1982, requesting a list of listed and proposed endangered and threatened species that may occur within the area of the subject project. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended (PL 95-632).

We have reviewed the most recent information and to the best of our knowledge there are no listed or proposed species within the area of the project. We appreciate your concern for endangered species and look forward to continued coordination. If you have further questions, please contact Mr. Swanson of our Endangered Species Field Office at (FTS) 448-2791 or (916) 440-2791.

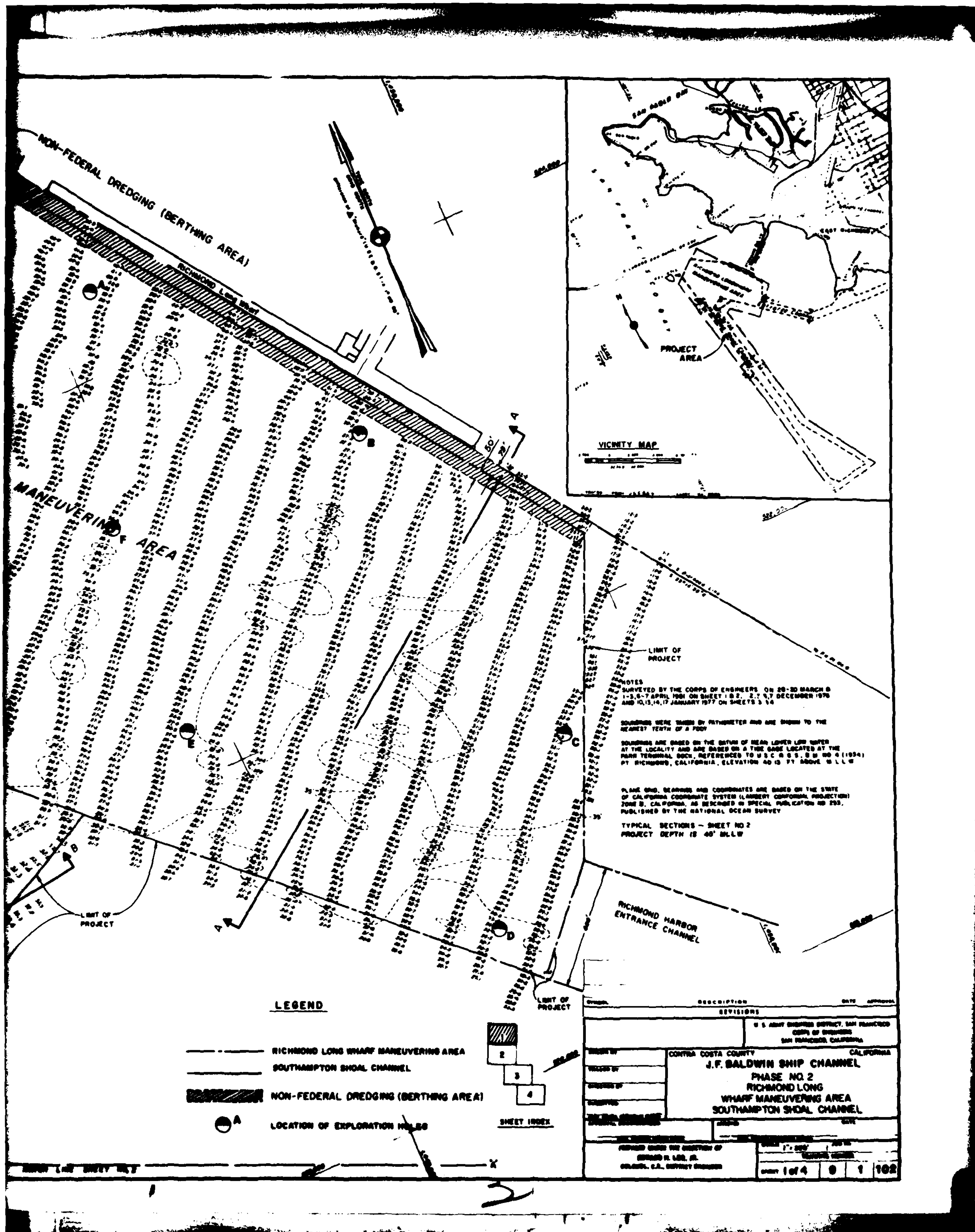
Sincerely,

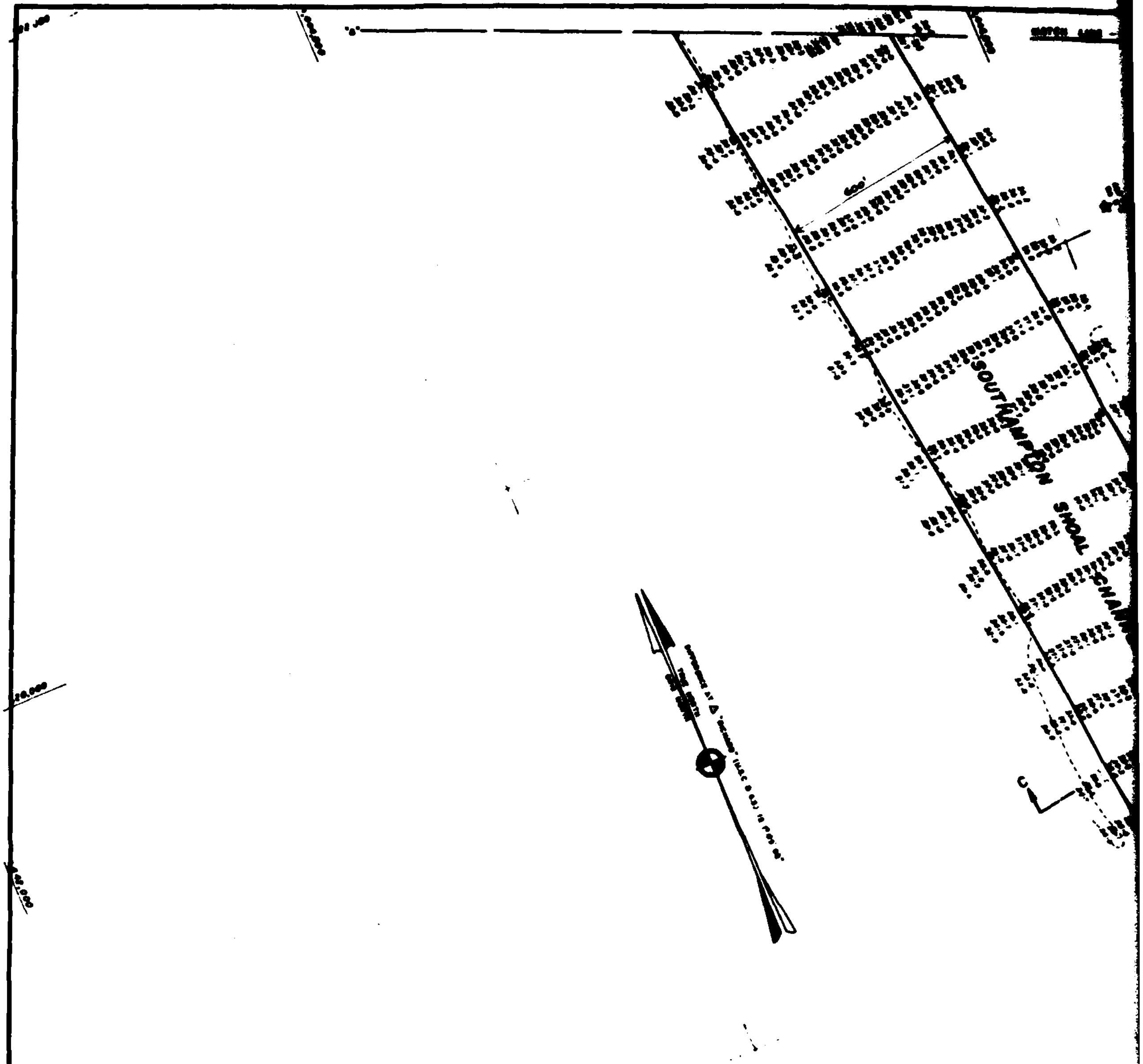
Area Manager

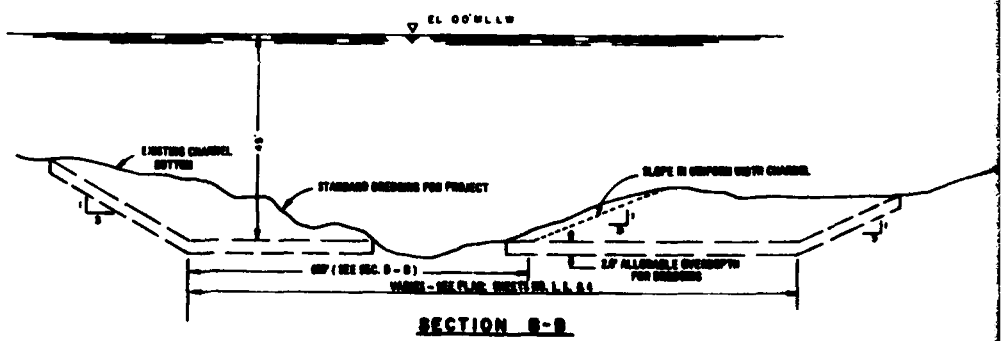
APPENDIX D
ENGINEERING DRAWINGS



NON-FEDERAL DRE
RICHMOND LONG WHARF MANEUVERING
LIMIT OF PROJECT
SOUTHAMPTON SHOAL CHANNEL
(To be relocated)
FOR TYPICAL SECTION SEE SHEET NO. 2
LIMIT OF PROJECT
B
B
'A'

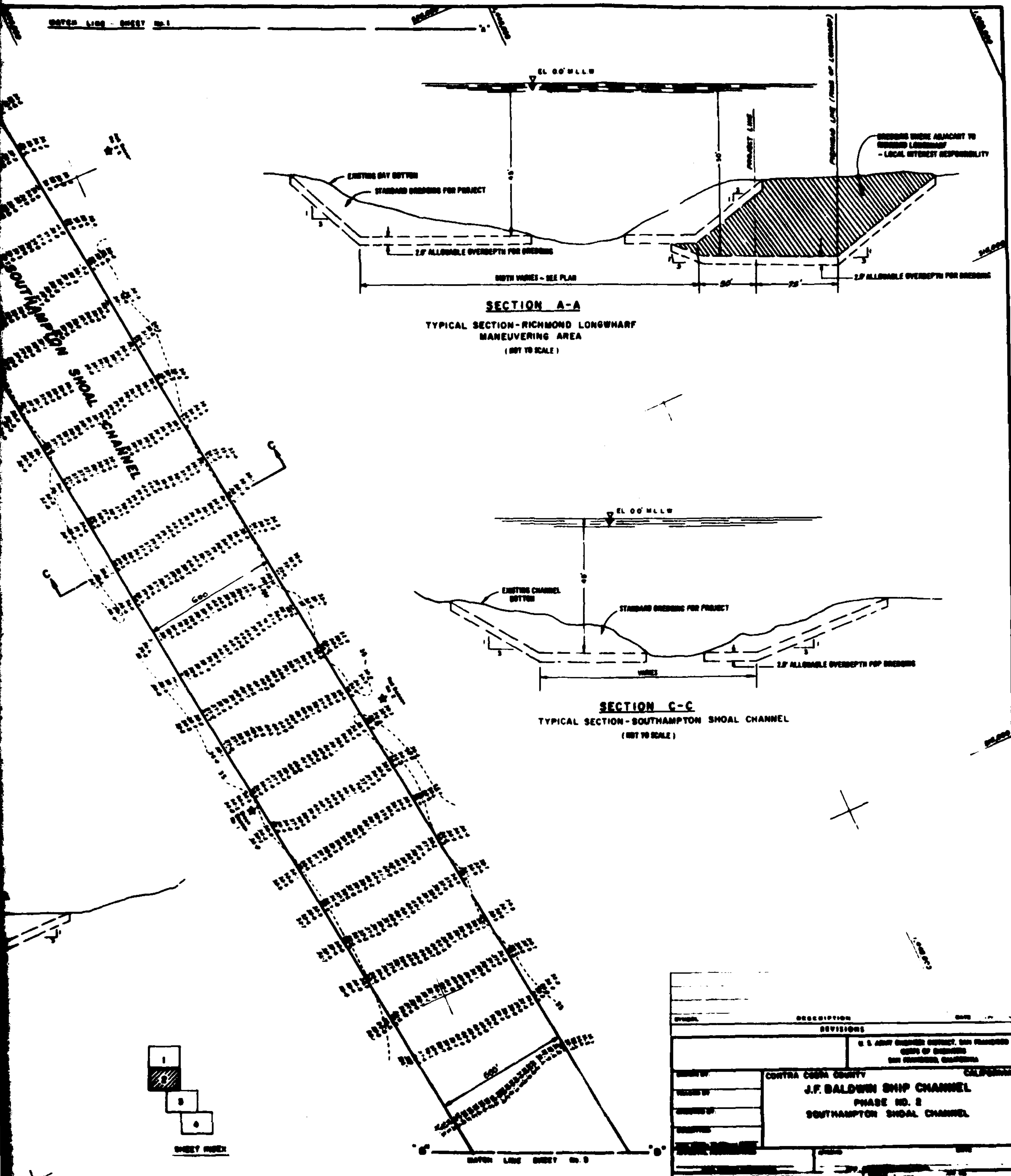

NON-FEDERAL DREDGING (BERTHING AREA)
RICHMOND LONG WHARF
MANEUVERING AREA
LIMIT OF PROJECT
RICHMOND HARBOR ENTRANCE CHANNEL
VICINITY MAP
PROJECT AREA
NOTES
SURVEYED BY THE CORPS OF ENGINEERS ON 28-30 MARCH & 1-3, 6-7 APRIL 1961 ON SHEET 1 & 2, 2,7 & 7 DECEMBER 1976 AND 10,13,14,17 JANUARY 1977 ON SHEETS 3 & 4
TYPICAL SECTIONS – SHEET NO 2
PROJECT DEPTH IS 45' MLLW
LEGEND
RICHMOND LONG WHARF MANEUVERING AREA
SOUTHAMPTON SHOAL CHANNEL
NON-FEDERAL DREDGING (BERTHING AREA)
LOCATION OF EXPLORATION HOLES
SHEET INDEX
DESCRIPTION
REVISIONS
CONTRA COSTA COUNTY
CALIFORNIA
J.F. BALDWIN SHIP CHANNEL
PHASE NO. 2
RICHMOND LONG
WHARF MANEUVERING AREA
SOUTHAMPTON SHOAL CHANNEL
1 of 4
102





SECTION B-B

TYPICAL SECTION - SOUTHAMPTON SHOAL CHANNEL
TRANSITION REACHES
(NOT TO SCALE)



CONTRA COSTA COUNTY CALIFORNIA

J.F. BALDWIN SHIP CHANNEL

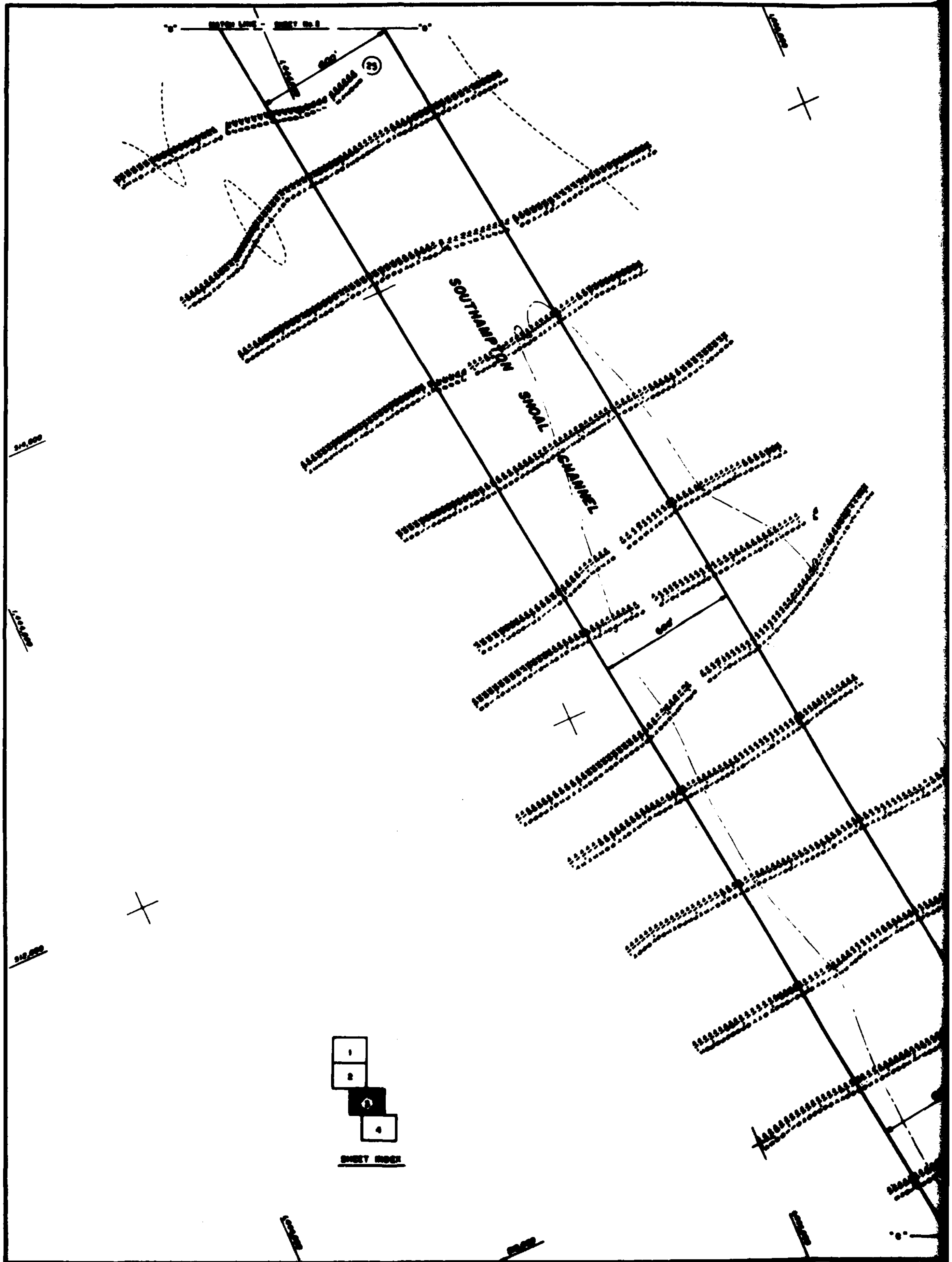
PHASE NO. 2

SOUTHAMPTON SHOAL CHANNEL

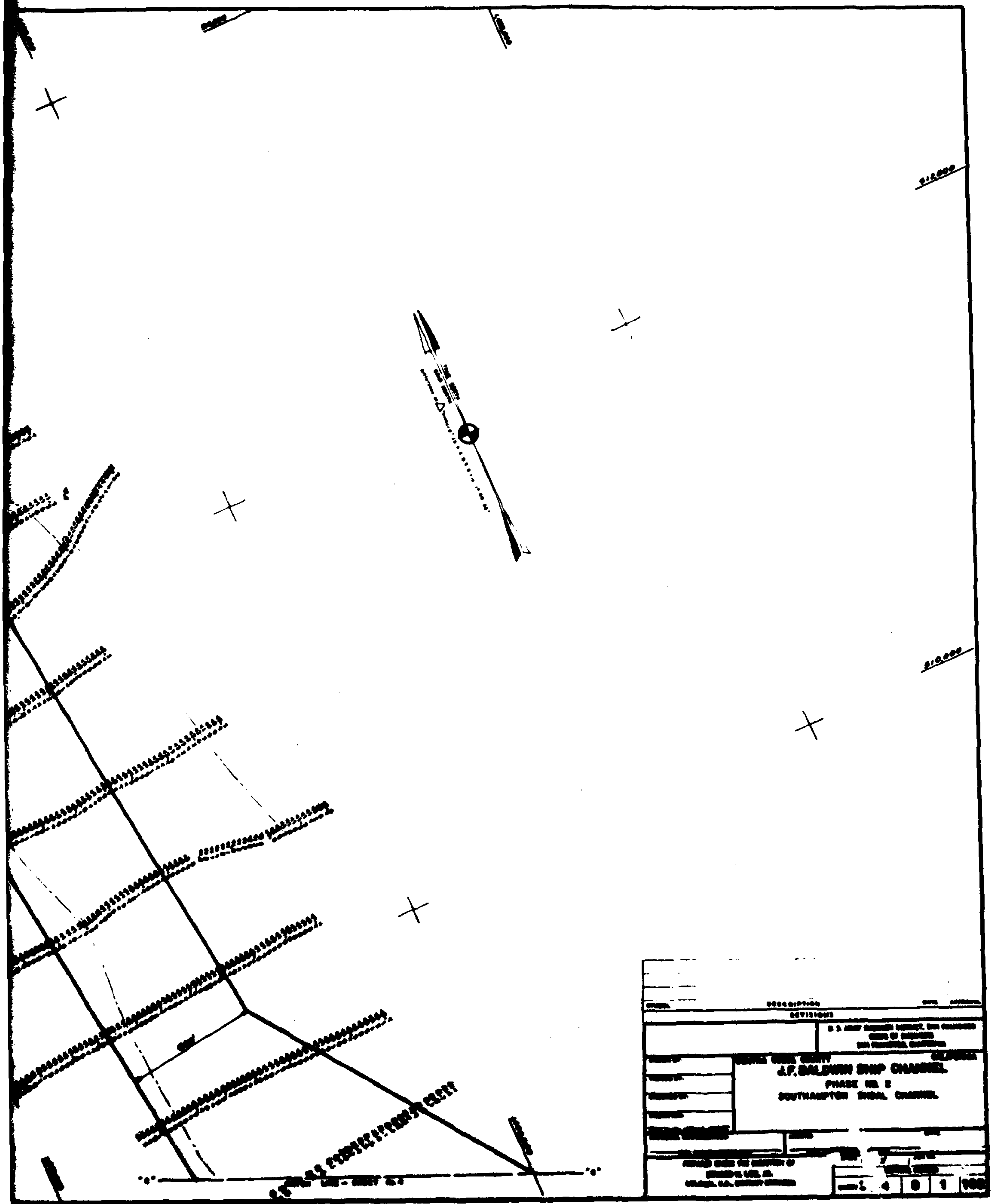
REVISIONS

SHEET 2 of 4 | 0 | 1 | 102

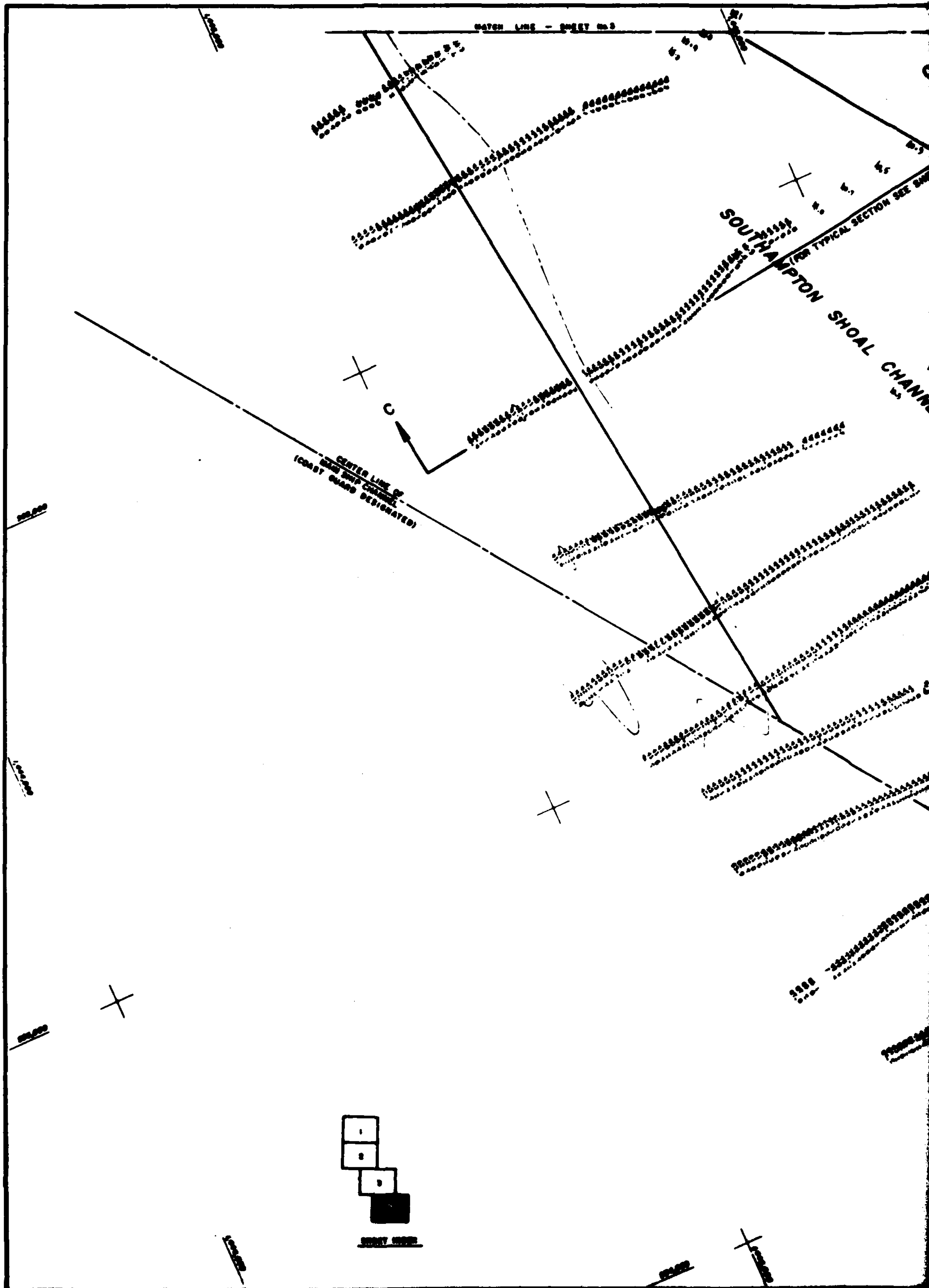
l 2

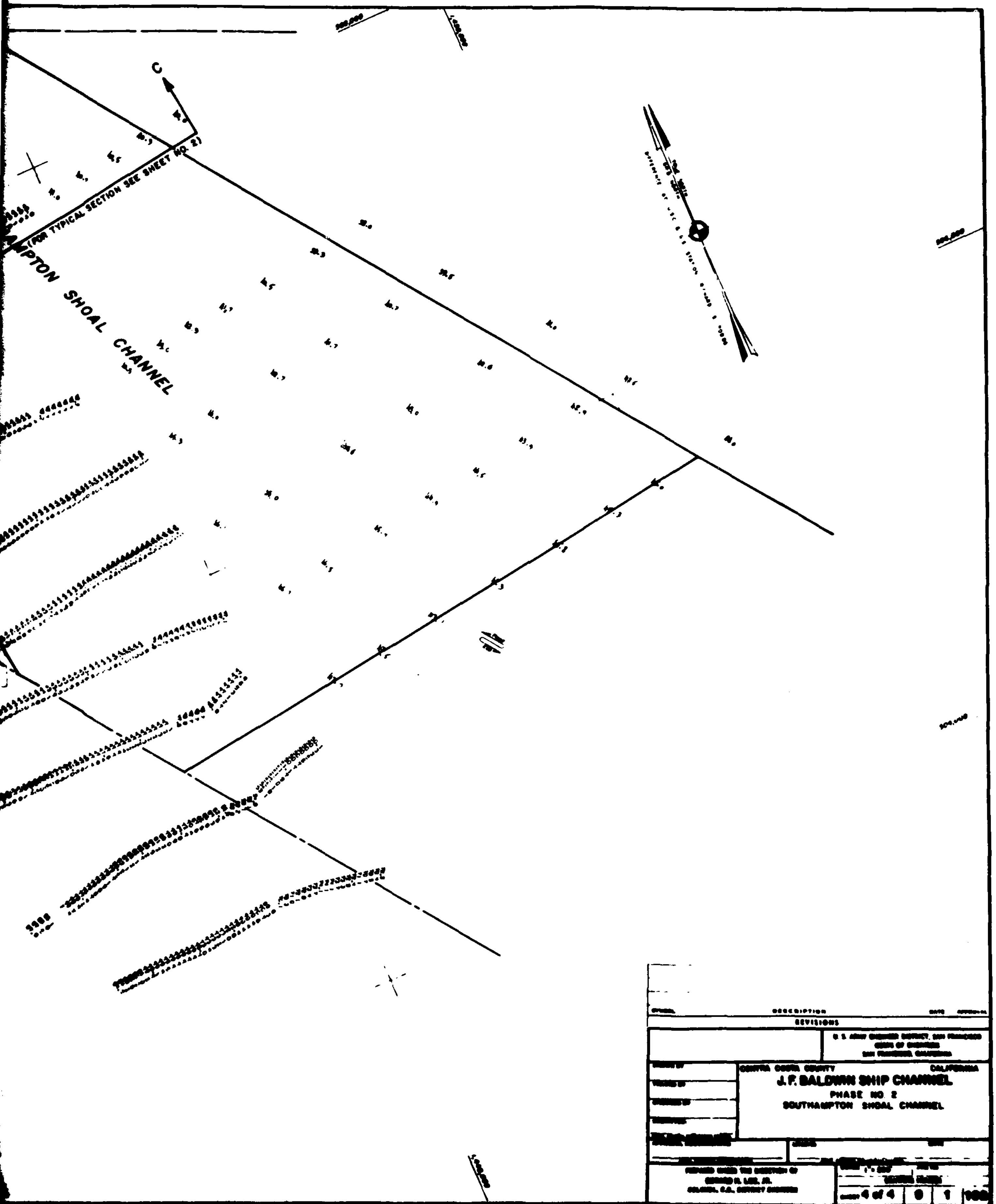


SOUTHAMPTON SHOAL CHANNEL
600'
1
2
4
SHEET INDEX


DESCRIPTION
REVISIONS
J.F. BALDWIN SHIP CHANNEL
SOUTHAMPTON SHOAL CHANNEL

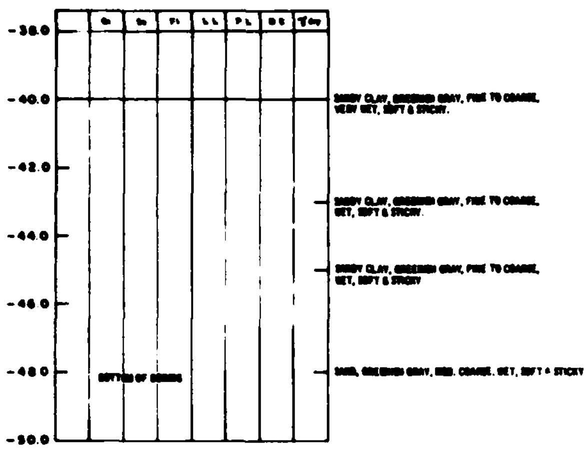
1 2


MATCH LINE - SHEET No.3
SOUTHAMPTON SHOAL CHANN
(FOR TYPICAL SECTION SEE SH
CENTER LINE OF
MAIN SHIP CHANNEL
(COAST GUARD DESIGNATED)
C
1
2
3



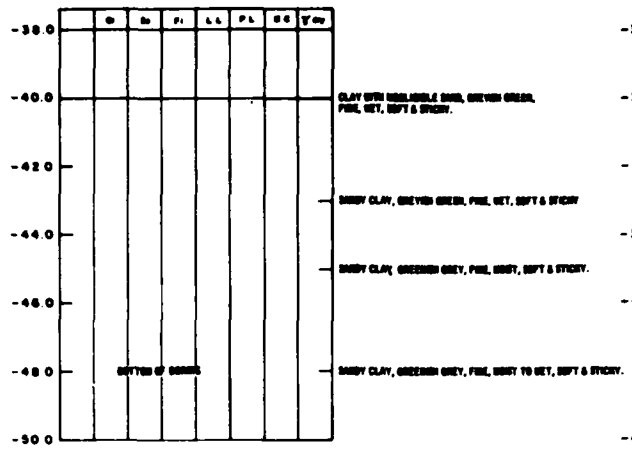
C
(FOR TYPICAL SECTION SEE SHEET NO. 2)
SHOAL CHANNEL
DESCRIPTION
REVISIONS
CONTRA COSTA COUNTY
CALIFORNIA
J. F. BALDWIN SHIP CHANNEL
PHASE NO. 2
SOUTHAMPTON SHOAL CHANNEL
4 of 4
1

A



-38.0
-40.0
-42.0
-44.0
-46.0
-48.0
-50.0

B



-38.0
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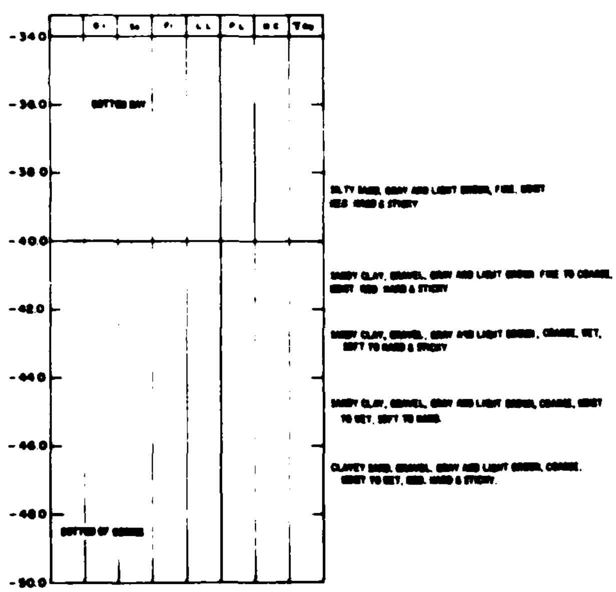
E



-34.0
-36.0
-38.0
-40.0
-42.0
-44.0
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-48.0
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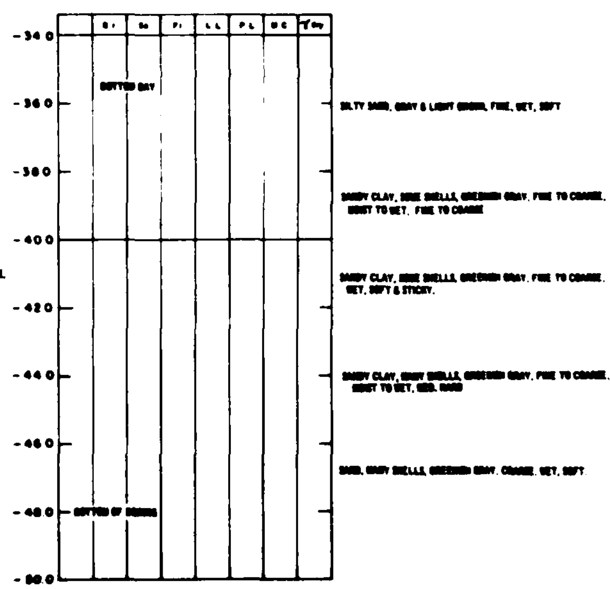
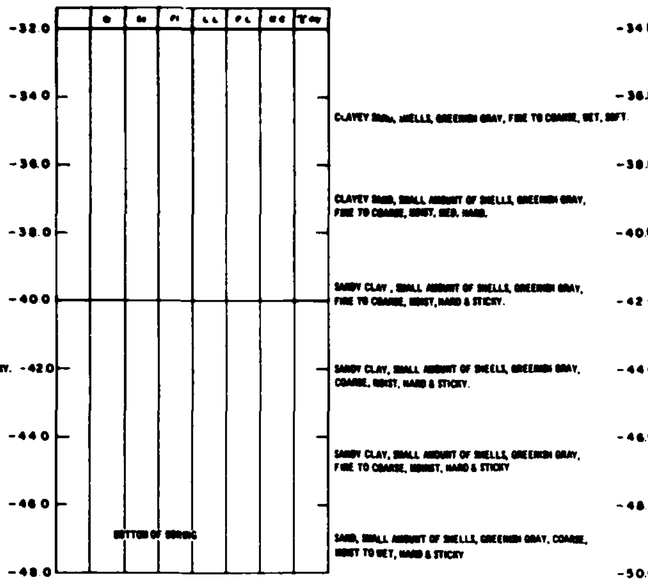
F

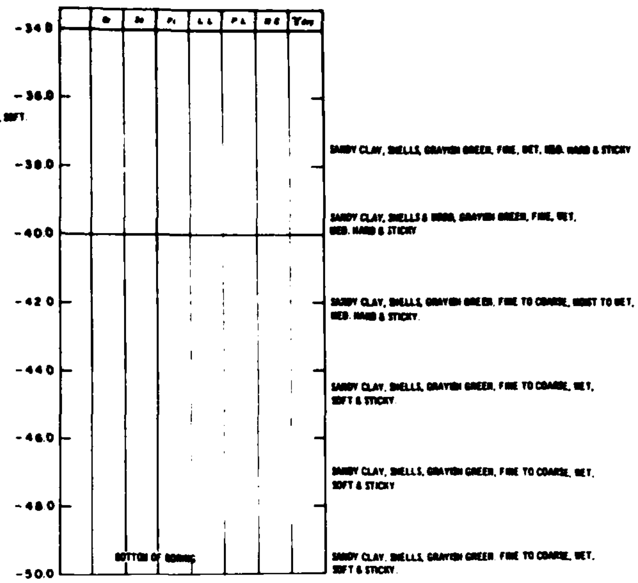


-34.0
-36.0
-38.0
-40.0
-42.0
-44.0
-46.0
-48.0
-50.0

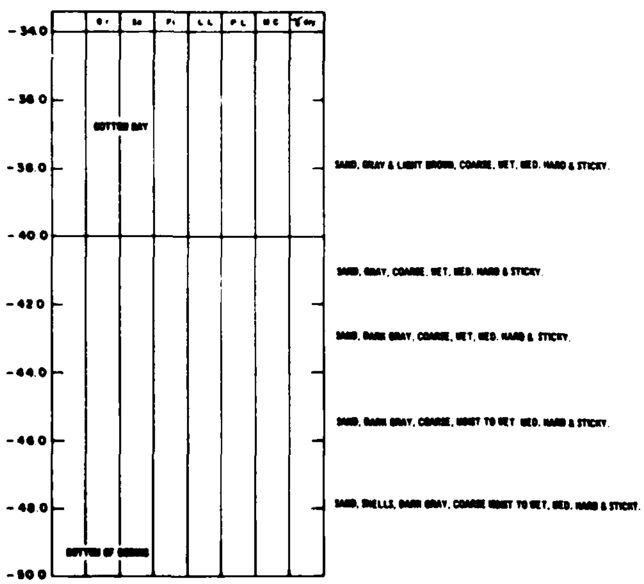
C



D



G



REVISIONS

U. S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

CONTRA COSTA COUNTY CALIFORNIA

J. F. BALDWIN SHIP CHANNEL
PHASE NO. 2
LOGS OF EXPLORATION HOLES
RICHMOND LONGWHARF MANEUV. AREA

PREPARED UNDER THE DIRECTION OF
EDWARD R. LEE, JR.
COLONEL, C.E., DISTRICT ENGINEER

SHEET 1 of 1 | 9 | 5 | 6

1 2

APPENDIX E
CULTURAL RESOURCES

This appendix consists of Cultural Resources Section taken from Appendix F of the Richmond Harbor Feasibility Report, 1981. A new cultural resources survey was not conducted for the subject study as the Richmond Harbor survey included the Richmond Long Wharf area. In addition none of the final action alternatives discussed in the subject study will affect land areas and the aquatic areas impacted are located in deep water with swift currents.

CULTURAL RESOURCES

CULTURAL RECONNAISSANGE

1.13 A thorough literature search was performed for the area which included, but was not limited to, examination of maps, records and scholarly publications on file at the District 01 Clearinghouse, Department of Anthropology, California State University at Sonoma, State Department of Parks and Recreation, University of California in Berkeley; Richmond Main Library, Historical Section, Richmond Museum and the Contra Costa Historical Society.

1.14 Aerial photos of the Richmond Harbor taken by the Corps in May 1963 were analyzed for possible identification of areal cultural resources. There was no indication of terrestrial or submerged cultural resources within or immediately adjacent to the project area. Mrs. Ethel Kerns, President of the Richmond Museum Society and long-term resident of Richmond was contacted in person at the museum on 14 October 1976, and it was her determination that no cultural resources exist within or immediately adjacent to the proposed project area.

1.15 Mr. L. Stein of the Contra Costa Historical Society was contacted in person on 14 October 1976, and it was his determination that no known cultural resources or items of historical interest currently exist within or immediately adjacent to the proposed project area.

1.16 The Preliminary Historic Resources Inventory, Contra Costa County, California 1976 was consulted and no previously unmentioned registered sites of historic resources occurred within or adjacent to the project area.

DESCRIPTION OF KNOW SITES IN GENERAL STUDY AREA

1.17 Several significant archaeological sites have been identified in the near vicinity of the proposed project area. Research substantiates proto-historic and prehistoric Native American habitation of the area and reflects the interesting geologic history of the San Francisco Bay. Many of the known sites are partially submerged below bay waters, but retain substantial site integrity and research potential.

1.18 One such site, the Ellis Landing Site (CA-CCO-295), exists immediately adjacent to the proposed project area and consisted of an elliptical shaped habitation midden which, prior to extensive historic disturbance, may have measured approximately 460 feet in diameter at the base along a north-west-southeast axis, by 245 feet in width, by 33 feet in height; 17 feet extended vertically above marsh level and 16 feet extended below marsh level. Utilizing a Danish formula, the estimated age of the midden is roughly 3,500 years. Although the ethnographic record fails to document Coastanoan midden habitation or territorial occupation for the entire period represented by the midden, it is reasonable to assume that at least the uppermost levels of the midden may have been attributable to Coastanoan habitation. The contemporary average depth of water between Brooks Island and the Parr-Richmond Terminal No. 3 General Cargo Wharf (Benchmark 13 on U.S.G.S. Richmond Quadrangle) is 2 feet.

1.19 Historically, Ellis Landing was located immediately adjacent to the project area near the current site of the Parr Oil Dock. The landing was a 19th century commercial enterprise begun by Mr. George Ellis and consisted of a wharf, warehouse and residential structure. All improvements were completely destroyed circa 1929-30 prior to construction of the Richmond Harbor facilities. The area was subsequently elevated using landfill borrowed from Easter Hill in Richmond. No other structures or known cultural resources exist within, or adjacent to, either of the proposed project areas. The Ellis Landing Site was extensively damaged due to construction activities and landfill shortly after the beginning of the 20th century.

1.20 Several prehistoric sites have been identified on Brooks Island to the south of Ellis Landing. One such site is partially submerged under Bay waters, but the parameters of the site do not extend sufficient distance to be impacted by either of the proposed project alternatives.

1.21 The Ellis Landing Site and the Brooks Island sites are located on a shallow alluvial terrace which runs on a north-south axis decreasing in elevation to the west toward Southampton Shoal. On the basis of recent geologic data and calculation of early Holocene sea-level changes, it is likely that the greater portion of the alluvial terrace was above sea level circa 8,000 B.C. and accessible by foot from the present shoreline approximately 2 miles to the west. As the rate of increase in Holocene sea-level declined, the rate of natural sedimentation increased resulting in the accumulation of Younger Bay Mud. The siltation process was greatly accelerated in the late 19th century as a result of hydraulic mining activites in the Sierra-Nevada foothills to the east.

ASSESSMENT OF RECONNAISSANCE

1.22 No cultural resources are known to exist within the proposed project area and it is considered improbable that the recommended harbor improvements in the form of deepening the existing channel would encounter submerged resources. Waterborne traffic and annual maintenance dredging of the channel since construction in 1932 have severely disturbed channel sediments. The proposed dredge depth is -41 feet MLLW. Soundings and pollution samples taken from within the channel in August 1976 indicate that significant portions of the existing channel are currently maintained to a depth approximately -35 feet MLLW, with an allowable two feet overdepth. Analysis of sediment samples taken from the Richmond Harbor Entrance Channel indicates that dredged materials below -35 feet MLLW consist of disturbed Younger Bay Mud. Analysis of sediment samples secured from the Potrero Point Reach, Potrero Point Turn and Harbor Channel indicate that materials dredged to the recommended depth would consist of more consolidated deposits of Older Bay Mud.

1.23 Based on the above data, the channel bottom area with the greatest potential for submerged cultural resources is the Richmond Harbor Entrance Channel. The Holocene sediments in this reach have been severely disturbed to the extent that site integrity and research potential would be minimal. Because of these factors no program of sediment sampling or monitoring of dredge materials is anticipated for existing channel reaches at this time.

1.24 The creation of a turning basin shall result in the disturbance and relocation of a significant portion of previously undisturbed Bay sediment. Although no substantive evidence exists documenting the presence of submerged cultural resources, the geologic and archaeologic records indicate that the area is archaeologically "sensitive," or has a high potential as a source of archeological material. Should the review of core samples of sediments in the proposed turning basin indicate the presence of submerged cultural resources, further testing and analysis of the channel bottom area would be considered on the basis of the data.

1.25 The Ellis Landing Site (CA-CCO-295) which is located immediately adjacent to the project area shall not be adversely impacted, either directly or indirectly, by the proposed project.

1.26 The Brooks Island sites which are located outside the project area shall not be adversely impacted, either directly or indirectly, by the proposed project. It is likely that the dredging activities within the project area shall generate increased particulate suspension and accelerate sediment accumulation in the area of the sites. This is not considered to be either an adverse or beneficial impact. The channel deepening shall not result in unstable sidewalls which might slump and endanger site integrity in the Brooks Island area.

1.27 There shall be no adverse primary or secondary impacts on submerged cultural resources within the proposed dredge disposal area. The aquatic disposal of dredged materials at the Alcatrz and/or 100-fathom sites poses no threat to cultural resources because the site has been used as a disposal site for dredged materials since the 1930's and is subject to heavy underwater scouring due to tidal action.

CONCLUSIONS

1.28 In compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470(f)), and Executive Order 11593, of 13 May 1971, the following actions have been taken:

A. The most recent listing of the National Register of Historic Places (with monthly supplements up to and including 3 February 1981) has been consulted with the result that no properties listed in, or eligible for listing in, the National Register of Historic Places, were found to be within or adjacent to the project area (including disposal sites).

B. Request has been made of the State Office of Historic Preservation for information concerning any areal cultural resources which could be impacted by the proposed project.

C. A literature search was conducted at the Regional Office of the California Archaeological Site Survey, Sonoma State University, Rohnert Park, California, with the result that archaeological sites have been located in the vicinity of, but not within, the project area. The archaeological sites consist of CA-CCO-295 and the Stege Mounds (CA-CCO-297, 298, 299, and 300) on the mainland, and several prehistoric sites on Brooks Island.

1.29 It is the Corps' determination that there is little or no potential for the existence of significant cultural resources within the project area. This determination is based upon the fact that the dredging and disposal areas which comprise the project area are entirely submerged beneath the waters of San Francisco Bay. Should archaeological sites have existed within the project area (prior to submergence by rising bay waters) it is likely that they would have lost their integrity and research potential as a result of the horizontal fluctuation of bottom sediments caused by man-made and/or natural currents. In addition, most of the project area has been disturbed by either previous dredging or disposal. The Richmond Harbor Channel, and the Southampton Shoal Channel have both been dredged to depths ranging from -35 to -37 feet below MLLW. A large section of the New Turning Basin was previously dredged to create the Old Ford Channel. The disposal area off Alcatraz has been used for dredged materials since the 1930's.

1.30 All archaeological sites refered to, with the exception of one, are located entirely on uplands and will be neither directly nor indirectly affected by the proposed project. One archaeological site, located on Brooks Island, extends below Mean Higher High Water, although no portion of the site extends into the area to be dredged. Dredging would not affect the partially submerged archaeological site in that: (1) No portion of the site would be excavated by dredging, and (2) the dredge would not create waves or currents which would impact the site.

DAT

ILM